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Bulletin 100

VOLUME 14, PART 1

CONTRIBUTIONS TO THE BIOLOGY OF THE PHILIPPINE ARCHIPELAGO AND ADJACENT REGIONS

REPORT ON THE ECHINOIDEA COLLECTED BY THE UNITED STATES FISHERIES STEAMER "ALBATROSS" DURING THE PHILIPPINE EXPEDITION, 1907–1910. PART 2: THE ECHINOTHURIDAE, SALENIIDAE, ARBACIIDAE, ASPIDODIADEMATIDAE, MICROPYGIDAE, DIADEMATIDAE, PEDINIDAE, TEMNOPLEURIDAE, TOXOPNEUSTIDAE, AND ECHINOMETRIDAE

By

THEODOR MORTENSEN

SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM
WASHINGTON
D. C.

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By
THEODOR MORTENSEN

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REPORT ON THE ECHINOIDEA COLLECTED BY THE UNITED STATES FISHERIES STEAMER "ALBATROSS" DURING THE PHILIPPINE EXPEDITION, 1907–1910. PART 2: THE ECHINOTHURIDAE, SALENIIDAE, ARBACIIDAE, ASPIDODIADEMATIDAE, MICROPYGIDAE, DIADEMATIDAE, PEDINIDAE, TEMNOPLEURIDAE, TOXOPNEUSTIDAE, and ECHINOMETRIDAE

By Theodor Mortensen

INTRODUCTION

The first part of the report on the Echinoidea of the *Albatross* Philippine Expedition,[1] published in 1927, dealt with the family Cidaridae. The present second part is concerned with the families Echinothuridae, Saleniidae, Arbaciidae, Aspidodiadematidae, Micropygidae, Diadematidae, Pedinidae, Temnopleuridae, Toxopneustidae, and Echinometridae.

The Echinothuridae are represented in the collection by 16 species and 2 varieties, and there are in addition a couple of young specimens of *Sperosoma* not indentifiable with certainty as to species. The Saleniidae are represented by only one species with a variety, and the Arbaciidae by 4 species. The Aspidodiadematidae are represented by 3 species, the Micropygidae by 2, the Diadematidae by 7, the Pedinidae by 2, the Temnopleuridae by 15 (with in addition 2 unidentifiable tests), the Toxopneustidae by 2, and the Echinometridae by 8.

Of the Echinothuridae, four represent new species, one of these being the type of a new genus, *Hemiphormosoma;* also, there are two new varieties. These were briefly described by me in 1934.[2] A new variety in the Saleniidae found in the collection was described at the same time.

There are described herein four new species, one in the Diadematidae (*Eremopyga debilis*), one in the Pedinidae (*Caenopedina annulata*), one in the Temnopleuridae (*Microcyphus excentricus*), and one in the Echinometridae (*Echinostrephus formosus*).

[1] U. S. Nat. Mus. Bull. 100, vol. 6, pt. 4, pp. 243–312, 22 figs., 33 pls., 1927.
[2] Vid. Medd. Dansk Naturh. Foren., vol. 98, pp. 162–164, 1934.

Of particular importance are *Hemiphormosoma paucispinum* and *Paraphormosoma alternans*, both representing new generic types related to *Phormosoma* and necessitating the establishment of a separate subfamily, the Phormosominae, for this group of genera, the other genera forming another subfamily, the Asthenosominae. A third subfamily, the Kamptosominae, is not represented in the present collection.

A rather extraordinary fact relating to the biology of the deep-sea echinothurids was substantiated by a study of this material, together with that collected by myself south of Mindanao in 1914, and that is, that most of them are plant-feeders. The contents of their alimentary canal consists almost exclusively of small bits of plants, looking, indeed, like chaff; and it is not algae, but the remains of land plants. This sounds rather paradoxical—deep-sea animals feeding on land plants! But the explanation is not difficult. In areas with a luxurient tropical vegetation, like the Philippines, a large quantity of plant material is carried out to sea and after drifting around for some time ultimately sinks to the bottom and thus provides food for such bottom organisms as prefer this kind of nourishment. That it may be quite a considerable quantity of plant material that thus sinks to the bottom I have myself had the opportunity of observing through the medium of some trawlings off the southern coast of Mindanao, the mud contained in the trawl consisting largely of decaying vegetable matter.

Not all the deep-sea echinothurids are vegetarians. Thus specimens of *Phormosoma bursarium*, taken in the same haul with *Hygrosoma luculentum*, had only pure mud in the intestinal canal, whereas the Hygrosomas had their intestines filled with plant material. This is the more remarkable since the sharp, pointed teeth of *Phormosoma* would seem poorly adapted for mud eating.

The imbrication of the plates of the echinothurids, combined with their mostly very delicate structure and the great size attained by most of these deep-sea echinoids, results in the deplorable fact that they are as a rule very poorly preserved—flattened like a pancake and very often torn to pieces—thus giving a very poor idea of what these sea-urchins really look like. Having for a long time deplored this fact, I conceived the idea that it might, by carefully stuffing them, be possible to make them assume, at least to some degree, their natural shape. The idea proved a decided success, and I succeeded in making even hopelessly torn individuals assume a tolerably good shape. Such stuffed specimens will retain their form equally well in alcohol or in a dried condition.

The number of species of echinothurids known from the Malayan seas is very considerable—21 out of a total number of about 50. A

comparison with the West Indian seas, from which we know altogether only five species, shows strikingly that in regard to the echinothurids, as with the cidarids, the Malayan region is extraordinarily rich, probably the richest in the world.

With regard to the saleniids there is no such preponderance, the few surviving representatives of this formerly so flourishing group being about equally richly—or poorly—represented in the Indo-Pacific and Atlantic areas.

Of the arbaciids, the few small deep-sea forms known are rather equally distributed, like the saleniids. But out of the nine species of the large and splendid *Coelopleurus* type, the Malayan region with four species as contrasted with only one in the West Indies stands as the richest region. As a small compensation for this relative poverty of the Atlantic area stands the fact that the genus *Arbacia* is confined exclusively to the Atlantic region and the west coast of America, no representative of this genus, or of the related genus *Tetrapygus*, being found anywhere in the Indo-Pacific region. Statements in the older literature of the occurrence of species of *Arbacia* or of *Tetrapygus* in the Indo-Pacific, as for instance at Zamboanga, are all erroneous, based upon old and unreliable labels. Also in the material sent me from the United States National Museum there is a specimen of *Tetrapygus niger* labeled "Philippines; G. B. Steere; Acc. No. 39067." That the label is wrong is beyond doubt.

I am under the greatest obligation to Dr. Alexander Wetmore, in charge of the National Museum, for permitting me to include in volume 2 of my Monograph of the Echinoidea descriptions and illustrations of various new forms in the families herein dealt with that were found in the *Albatross* collection. If I had had to wait for the publication of this part of the *Albatross* report before I could deal with these forms in the Monograph, it would have delayed the publication of the Monograph very considerably. From a scientific point of view also it is more satisfactory to have the full descriptions and the figures of the various new forms from the *Albatross* collection in the right systematic place in the Monograph, instead of mere references to the *Albatross* report. Now I may in the main restrict the mention of the new forms in the *Albatross* report to references to the Monograph.

It may be taken as a matter of course that all the material representing already known species contained in the *Albatross* collection has been made use of in working out that Monograph, it being of the greatest importance to have that work based upon as extensive material as possible.

Order LEPIDOCENTROIDA

The reasons for uniting the echinothurids with the lepidocentrids in a single order, the Lepidocentroida, are given in the Monograph of the Echinoidea, vol. 2, pp. 114–121.

Family ECHINOTHURIDAE

Subfamily PHORMOSOMINAE

Genus PHORMOSOMA Wyville Thomson

PHORMOSOMA BURSARIUM A. Agassiz

Phormosoma bursarium A. AGASSIZ, *Challenger* Reports, Zoology, vol. 3, pt. 9, Echinoidea, p. 99, pl. 10, b, 1881.—MORTENSEN, Monograph of the Echinoidea, vol. 2, p. 135, pl. 2, fig. 20; pl. 3, figs. 1, 2; pl. 74, figs. 11–15, 1935.

Phormosoma indicum DÖDERLEIN, Wiss. Ergebn. Tiefsee-Exped., vol. 5, Lief. 2, p. 130, pl. 15, figs. 1, 2; pl. 38, figs. 2, 3, 1906.

Localities.—Station 5116; Verde Island passage; Sombrero Island bearing N. 69° E., 2.5 miles distant (lat. 13°41′00″ N., long. 120° 47′05″ E.); 366 meters; bottom temperature 10.11° C.; January 20, 1908. Four specimens.

Station 5122; east coast of Mindoro; Malabrigo Light bearing N. 46° W., 20.6 miles distant (lat. 13°21′30″ N., long. 120°30′33″ E.); 402 meters; green mud; February 2, 1908. Several young specimens.

Station 5123; east coast of Mindoro; Malabrigo Light bearing N. 44° W., 32.5 miles distant (lat. 13°12′45″ N., long. 121°38′45″ E.); 507 meters; green mud; February 2, 1908. Four specimens.

Station 5124; east coast of Mindoro; Point Origon (N.) bearing S. 56° E., 20.75 miles distant (lat. 12°52′00″ N., long. 121°48′30″ E.); 514 meters; soft green mud; February 2, 1908. Eight specimens.

Station 5183; between Panay and Negros; Lusaran Light bearing S. 29° E., 4 miles distant (lat. 10°32′48″ N., long. 122°26′00″ E.); 175 meters; bottom temperature 17.44° C.; soft green mud; March 30, 1908. Several specimens.

Station 5219; between Marinduque and Luzon; Mompog Island (NE.) bearing N. 35°30′ W., 12.25 miles distant (lat. 13°21′00″ N., long. 122°18′45″ E.); 969 meters; bottom temperature 10.44° C.; green mud; April 23, 1908. Three specimens.

Station 5221; between Marinduque and Luzon; San Andreas Island (W.) bearing S. 27° E., 5.5 miles distant (lat. 13°38′15″ N., long. 121°48′15″ E.); 353 meters; bottom temperature 11.33° C.; green mud; April 24, 1908. Three specimens.

Station 5259; off northwestern Panay; Caluya Island (S.) bearing S. 73° W., 12 miles distant (lat. 11°57′30″ N., long. 121°42′15″

E.); 570 meters; bottom temperature 9.61° C.; gray mud and globigerina ooze; June 3, 1908. Six specimens.

Station 5274; China Sea, in the vicinity of southern Luzon; Malavatuan Island (N.) bearing S. 73°30′ E., 17.5 miles distant (lat. 13°57′30″ N., long. 120°03′25″ E.); 960 meters; bottom temperature 5.17° C.; gray mud and sand; July 16, 1908. One specimen.

Station 5282; China Sea, in the vicinity of southern Luzon; Malavatuan Island (N.) bearing S. 84° W., 6.2 miles distant (lat. 13°53′00″ N., long. 120°26′45″ E.); 353 meters; bottom temperature 8.56° C.; dark gray sand; July 18, 1908. One specimen.

Station 5348; Palawan passage; Point Tabonan bearing S. 89° E., 33.5 miles distant (lat. 10°57′45″ N., long. 118°38′15″ E.); 685 meters; bottom temperature 13.56° C.; coral sand; December 27, 1908. Three specimens.

Station 5349; Palawan passage; Point Tobonan bearing N. 85° E., 45.2 miles distant (lat. 10°54′00″N., long. 118°26′20″E.); 1,334 meters; bottom temperature 4.78° C.; coral sand; December 27, 1908. Three specimens.

Station 5373; in the vicinity of Marinduque Island; Tayabas Light (outer) bearing N. 20° E., 15 miles distant (lat. 13°40′00″ N., long. 121°31′10″ E.); 618 meters; bottom temperature 11.00° C.; soft mud; March 2, 1909. One specimen.

Station 5378; in the vicinity of Marinduque Island; Mompog Island (E.) bearing N. 38° W., 17 miles distant (lat. 13°17′45″ N., long. 122°22′00″ E.); 722 meters; bottom temperature 10.22° C.; soft green mud; March 4, 1909. One specimen.

Station 5421; between Panay and Guimaras; Lusaran Point Light bearing S. 27° E., 5 miles distant (lat. 10°33′30″ N., long. 122°26′00″ E.); 250 meters; bottom temperature 14.67° C.; green mud; March 30, 1909. Four specimens.

Station 5423; Jolo (Sulu) Sea; Cagayan Island, Cagayanes Islands (S.) bearing S. 11° E., 4.8 miles distant (lat. 9°38′30″ N., long. 121°11′00″ E.); 929 meters; bottom temperature 9.89° C.; gray mud and coral sand; March 31, 1909. Four specimens.

Station 5441; west coast of Luzon; San Fernando Point Light bearing S. 87° E., 18.7 miles distant (lat. 16°38′00″ N., long. 119°57′18″ E.); 340 meters; bottom temperature 11.78° C.; May 10, 1909. One specimen.

Station 5444; east coast of Luzon; Atalaya Point, Batag Island, bearing S. 65° E., 5.1 miles distant (lat. 12°43′51″ N., long. 124°58′50″ E.); 563 meters; bottom temperature 7.39° C.; green mud; June 3, 1909. Two specimens.

Station 5447; east coast of Luzon; San Miguel Point bearing S. 7° W., 3.5 miles distant (lat. 13°28′00″ N., long. 123°40′18″ E.); 567

meters; bottom temperature 7.39° C.; green mud; June 4, 1909. One young specimen the identification of which is not beyond doubt.

Station 5467; east coast of Luzon; Atulayan Island (S.) bearing S. 79° W., 2.5 miles distant (lat. 13°35′27″ N., long. 123°37′18″ E.); 877 meters; gray mud; June 18, 1909. Three specimens.

Station 5494; between Leyte and Mindanao; Diuata Point (N.) bearing N. 74° W., 4.2 miles distant (lat. 9°06′30″ N., long. 125° 18′40″ E.); 1,239 meters; bottom temperature 11.83° C.; green mud and sand; August 2, 1909. Six specimens.

Station 5505; in the vicinity of northern Mindanao; Macabalan Point Light bearing S. 31° E., 7.7 miles distant (lat. 8°37′15″ N., long. 124°36′00″ E.); 402 meters; August 5, 1909. Two specimens.

Station 5512; in the vicinity of northern Mindanao; Camp Overton Light bearing S. 76° E., 14 miles distant (lat. 8°16′02″ N., long. 123°58′26″ E.); 813 meters; bottom temperature 11.56° C.; gray mud and fine sand; August 7, 1909. One specimen.

Station 5513; in the vicinity of northern Mindanao; Camp Overton Light bearing S. 67° E., 10.3 miles distant (lat. 8°16′45″ N.; long. 124°02′48″ E.); 923 meters; bottom temperature 11.56° C.; gray mud and fine sand; August 7, 1909. One specimen.

Station 5515; in the vicinity of northern Mindanao; Camp Overton Light bearing S. 26° E., 24.6 miles distant (lat. 8°34′48″ N., long. 124°01′24″ E.); August 8, 1909. Ten specimens.

Station 5536; between Negros and Siquijor; Apo Island (C.) bearing S. 26° W., 11.8 miles distant (lat. 9°15′45″ N., long. 123° 22′00″ E.); 510 meters; bottom temperature 11.95° C.; green mud; August 19, 1909. Two specimens.

Station 5565; between Jolo and Tawi Tawi; Dammi Island (N.) bearing S. 69° W., 6 miles distant (lat. 5°51′42″ N., long. 120° 30′30″ E.); 444 meters; bottom temperature 11.28° C.; sand and pteropod shells; September 21, 1909. Five specimens.

Station 5575; north of Tawi Tawi; Mt. Dromedario, Tawi Tawi, bearing S. 16° W., 19.2 miles distant (lat. 5°28′30″ N., long. 120° 02′27″ E.); 576 meters; bottom temperature 11.28° C.; coral sand; September 23, 1909. One specimen.

Station 5582; in the vicinity of Darvel Bay, Borneo; Si Amil Island (N.) bearing S. 82° W., 6.2 miles distant (lat. 4°19′54″ N., long. 118°58′38″ E.); 1,627 meters; bottom temperature 3.50° C.; gray mud and fine sand; September 26, 1909. One specimen.

Station 5586; Sibuko Bay, Borneo; Sipadan Island (M.) bearing W. 9.4 miles distant (lat. 4°06′50″ N., long. 118°47′20″ E.); 634 meters; bottom temperature 6.67° C.; gray mud; September 28, 1909. One specimen.

Station 5587; in the vicinity of Sibuko Bay, Borneo; Sipadan Island (W.) bearing S. 12° E., 3.8 miles distant (lat. 4°10′35″ N., long. 118°37′12″ E.); 759 meters; bottom temperature 5.72° C.; coral sand; September 28, 1909. Five specimens.

Station 5589; in the vicinity of Sibuko Bay, Borneo; Mabul Island (NW.) bearing N. 3° W., 2.8 miles distant (lat. 4°12′10″ N., long. 118°38′08″ E.); 475 meters; bottom temperature 7.61° C.; fine gray sand and gray mud; September 29, 1909. Three specimens.

Station 5592; in the vicinity of Sibuko Bay, Borneo; Silungan Island (M.) bearing N. 1° W., 6.4 miles distant (lat. 4°12′44″ N., long. 118°27′44″ E.); 557 meters; bottom temperature 6.28 C.; green mud; September 29, 1909. One specimen.

Station 5630; south of Patiente Strait; Doworra Island (N.) bearing N. 3° W., 4.5 miles distant (lat. 0°56′30″ S., long. 128°05′00″ E.); 1,040 meters; coral sand and mud; December 2, 1909. One specimen.

Station 5638; in the vicinity of Bouro Island; Tifu Bay entrance (W.) bearing N. 17° E., 3.2 miles distant (lat. 3°47′15″ S., long. 126°23′40″ E.); 945 meters; fine gray sand; December 10, 1909. One specimen.

Remarks.—The specimens are on the whole in poor condition. Most of them are small or of medium size. Those from station 5122 are particularly interesting, being the youngest known of this species, ranging from about 15 to 30 mm. in diameter. They show that the genital pores begin to appear at a size of approximately 25 mm. diameter. In the smallest specimen the genital and ocular plates are not yet completely separated.

In a specimen from station 5421 I find the spines of the aboral side more or less thorny, thus recalling to some degree *Phormosoma verticillatum;* but the thorns are not arranged in whorls as is so characteristic of *P. verticillatum.*

Most of the specimens are of the form designated by Döderlein as *Phormosoma indicum*, characterized by the aboral side being naked to a wide extent. There are, however, all transitions between such specimens, with an extensive naked part of the aboral side, to such as have all the plates of the aboral side provided with spines, so that I do not see any possibility of maintaining *P. indicum* as a distinct species, or even as a distinct variety.

PHORMOSOMA VERTICILLATUM Mortensen

Phormosoma verticillatum Mortensen, Ann. Mag. Nat. Hist., ser. 7, vol. 14, p. 90, pl. 4, figs. 1, 2; pl. 5, figs. 15–17, 1904; Monograph of the Echinoidea, pt. 2, p. 142, pl. 3, figs. 3, 4; pl. 4, fig. 4; pl. 74, figs. 7–10, 1935.

Phormosoma adenicum Döderlein, Wiss. Ergebn. Tiefsee-Exped., vol. 5, Lief. 2, p. 134, pl. 15, fig. 3; pl. 38, fig. 4, 1906.

Locality.—Station 5654; Gulf of Boni, Celebes; Cape Tabako bearing N. 17° E., 21.5 miles distant (lat. 3°42′00″ S., long. 120°45′50″ E.); 1,472 meters; December 18, 1909. Several specimens, most of them in poor condition.

Remarks.—It is beyond doubt that Döderlein's *Phormosoma adenicum* is identical with *P. verticillatum*. This seemed almost certain from the description and figures given by Döderlein, the lacking of the characteristic verticillate aboral spines being the only tangible difference. A reexamination of the type specimen of *P. adenicum*, kindly lent me by the Berlin Museum, showed, however, that the verticillate spines are actually present, and the identity of *adenicum* with *verticillatum* is thus definitely proved.

Parasite.—In the intestinal canal of this species was found a curious parasitic copepod, which has been described under the name *Dichelina phormosomae* by K. Stephensen.[3] The same species of parasite was found also in *Phormosoma bursarium*.

Genus HEMIPHORMOSOMA Mortensen

Hemiphormosoma Mortensen, Vid. Medd. Dansk Naturh. Foren., vol. 98, p. 162, 1934; Monograph of the Echinoidea, vol. 2, p. 149, 1935.

Characters.—This genus differs from *Phormosoma* in the very feeble development of the large areoles, which are confined to the two distalmost plates on the oral side, and the distalmost one on the aboral side. Also the fact that the demiplates of the ambulacra on the oral side are usually excluded from the edge of the ambulacral area is a noteworthy difference from *Phormosoma*. Whether the remarkably short valves of the tridentate pedicellariae represent a generic or merely a specific character cannot be decided so long as only a single species, the genotype, is known.

HEMIPHORMOSOMA PAUCISPINUM Mortensen

Figure 1

Hemiphormosoma paucispinum Mortensen, Vid. Medd. Dansk Naturh. Foren., vol. 98, p. 162, 1934; Monograph of the Echinoidea, vol. 2, p. 149, pl. 4, figs. 1–3; pl. 74, figs. 16–18, 1935.

Locality.—Station 5359; Jolo (Sulu) Sea; (lat. 8°12′45″ N., long. 120°37′15″ E.); 4,159 meters; January 9, 1909. Six specimens.

Remarks.—A full description of this species has been given in my Monograph of the Echinoidea. It may only be pointed out that the gill slits are exceptionally well developed for an echinothurid (fig. 1). The very delicate structure of the test appears to stand in relation to the very great depth at which this echinothurid lives. In this feature it recalls another deep-sea echinothurid, *Kamptosoma asterias* (A.

[3] Vid. Medd. Dansk Naturh. Foren., vol. 93, p. 207, 1933.

Agassiz), which occurs at about the same depths (3,890 to 4,950 meters).

Genus PARAPHORMOSOMA Mortensen

PARAPHORMOSOMA ALTERNANS (de Meijere)

Phormosoma alternans DE MEIJERE, *Siboga* Echinoidea, p. 31, pl. 3, figs. 21–22; pl. 12, figs. 143–148, 1904.

Paraphormosoma alternans MORTENSEN, Monograph of the Echinoidea, vol. 2, p. 152, pl. 4, figs. 5–8; pl. 76, figs. 14–16, 1935.

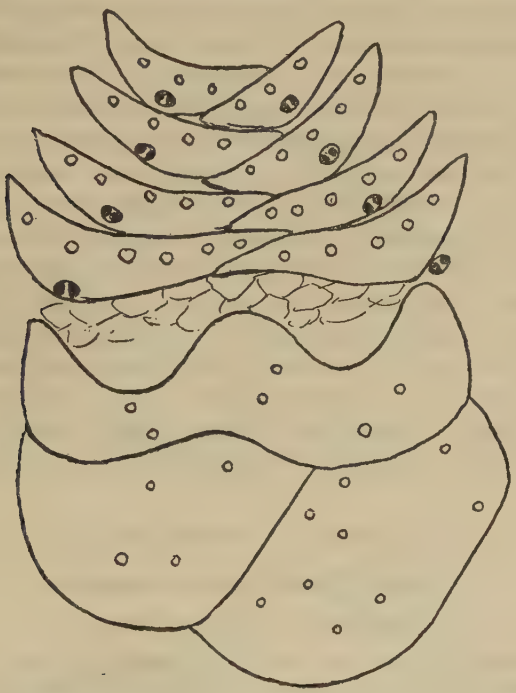

FIGURE 1.—Part of peristome and adjoining interambulacrum of *Hemiphormosoma paucispinum* Mortensen, showing the gill slits, i. e., the two notches in the adoral edge of the primordial interambulacral plate. The two series of peristomial ambulacral plates belong to two neighboring ambulacra. × 6.

Locality.—Station 5585.

Remarks.—It was a matter of great satisfaction to find in the *Albatross* material a specimen of this species, hitherto known only from the single specimen described in the *Siboga* Echinoidea. It is a good deal larger (74 mm. in diameter) than the type specimen (52 mm. in diameter). Still, it is not adult, as evidenced by the fact that genital pores have not yet been formed. This indicates that the species must grow to a much larger size and is therefore among the larger forms in the Echinothuridae.

The specimen is not in a very good state of preservation; particularly is it regrettable that all the primary spines of the oral side are broken, not one of them showing the skin bag enclosing the end of the spines. Still, there cannot be the slightest doubt of the correctness of the identification, the more so as I have had the type specimen for direct comparison.

The specimen was completely collapsed and partly torn. But by stuffing it, as explained above, I made it assume its natural shape, showing the shape of the test to be low-hemispherical.

Already de Meijere was in doubt whether this species could properly be referred to the genus *Phormosoma*. The careful study of the two known specimens that I have been able to undertake shows conclusively that it represents a distinct generic type. The main characters distinguishing it from *Phormosoma* are these: The areoles of the oral side are not sunken; there is no marginal fringe, the tubercles of the oral side continuing without interruption on to the aboral side; the edge of the test is not sharp, as in *Phormosoma*. The outer demiplate of the ambulacra on the aboral side remains broadly in contact with the interambulacral edge, this last character being from a morphological point of view the most important. In the larger *Albatross* specimen the outer demiplates even increase so much in size as to exclude the primary plates from the edge of the area; as a matter of fact, we have here a many-plated condition of the ambulacra directly comparable to that found in various Paleozoic echinoids.[4]

Subfamily ASTHENOSOMINAE

Genus TROMIKOSOMA Mortensen

TROMIKOSOMA TENUE (A. Agassiz)

Phormosoma tenue A. Agassiz, *Challenger* Reports, Zoology, vol. 3, pt. 9, Echinoidea, p. 91, pl. 13; pl. 14; pl. 17a, fig. 8; pl. 18a, figs. 1–13; pl. 18b; pl. 1 18c, figs. 5, 6, 8, 9; pl. 19a, fig. 2; pl. 42, fig. 7; pl. 44, figs. 7–9, 1881.

Echinosoma tenue Mortensen, *Ingolf* Echinoidea, pt. 1, pp. 56, 63, 177, pl. 12, figs. 35, 40, 1903; pt. 2, pp. 6, 21, 1907.—A. Agassiz and H. L. Clark, Hawaiian and other Pacific Echini, Echinothuridae, p. 165, pl. 67, figs. 12–21, 1909.

Tromikosoma tenue Mortensen, Monograph of the Echinoidea, vol. 2, p. 171, pl. 6, fig. 1; pl. 7, figs. 1–5; pl. 75, figs. 8–17, 1935.

Locality.—Station 5636; Pitt passage; Gomomo Island (E.) bearing N. 46° W., 6 miles distant (lat. 1°55′00″ S., long. 127°42′30″ E.); 2,307 meters; gray mud and fine sand; December 3, 1909. Three specimens.

Remarks.—That these specimens are identical with the typical *T. tenue* from off Japan is beyond doubt, and the occurrence in the Malay

[4] *Cf.* Mortensen, Monograph of the Echinoidea, vol. 2, p. 85, fig. 56, 1935.

region of this species, hitherto known only from the North Pacific (Japan to the Aleutian Islands) has thus been established. This distribution is in full accord with that of so many other deep-sea echinoderms that it might well have been expected in advance.

The name *Echinosoma* hitherto used for this and other species is preoccupied no less than three times—for a holothurian, a beetle, and an earwig. The name *Tromikosoma*, proposed by me in 1903 [5] for the species *koehleri*, which is undoubtedly congeneric with the present species, as is justly maintained by Agassiz and Clark, thus takes the place of *Echinosoma* as the name of the genus to which this species should be referred. Regarding the characters of this genus, in a restricted sense (Agassiz and Clark took it in a wide sense comprising also the genus *Hygrosoma*, which is entirely untenable), I must refer to my Monograph of the Echinoidea, vol. 2, p. 164.

Genus SPEROSOMA Koehler

SPEROSOMA CRASSISPINUM Mortensen

FIGURE 2

Sperosoma crassispinum MORTENSEN, Vid. Medd. Dansk Naturh. Foren., vol. 98, p. 163, 1934; Monograph of the Echinoidea, vol. 2, p. 195, pl. 9, fig. 2; pl. 10, fig. 2; pl. 77, figs. 13–17, 1935.

Locality.—Station 5616; Molucca passage; Tifore Island (C.) bearing N. 40° W. 35 miles distant (lat. 0°32′30″ N., long. 126°31′30″ E.); 1,866 meters; gravel; November 22, 1909. One specimen.

FIGURE 2.—Spicules from tubefeet of *Sperosoma crassispinum* Mortensen: *a*, From oral tubefoot; *b*, from aboral tubefoot. × 200.

Remarks.—A full description and figures of this specimen are given in my Monograph, to which the reader is referred. It has a size of about 145 mm. in diameter.

Besides by the rather coarse spines—a feature to which the specific name refers—this species differs markedly from the other known

[5] Mortensen, *Ingolf* Echinoidea, pt. 1, p. 62, 1903.

species of this genus in having the primary ambulacral plates of the aboral side undivided. The pedicellariae recall those of *Sperosoma grimaldii* Koehler, to which the present species has otherwise apparently no nearer relation.

I give here figures of the rather large spicules of the tubefeet (fig. 2), these having been inadvertently omitted from the Monograph.

SPEROSOMA TRISTICHUM Mortensen

Sperosoma tristichum MORTENSEN, Vid. Medd. Dansk Naturh. Foren., vol. 98, p. 163, 1934; Monograph of the Echinoidea, vol. 2, p. 197, pl. 12, figs. 2, 3; pl. 77, figs. 18–22, 1935.

Locality.—Station 5585; in the vicinity of Sibuko Bay, Borneo; Sipadan Island (M.) bearing S. 89° W., 12 miles distant (lat. 4°07′00″ N., long. 118°49′54″ E.); 870 meters; bottom temperature 5.06° C.; gray mud; September 28, 1909. One specimen.

Remarks.—Also of this species a full description, with figures, is given in my Monograph, to which the reader is referred. The specimen has a diameter of 95 mm.

This species differs markedly from the other known species of *Sperosoma* in the arrangement of the pores on the aboral side in arcs of three, instead of the usual arrangement in more or less regular quincunx. The pedicellariae are not very characteristic.

SPEROSOMA species (juv.)

FIGURE 3

Localities.—Station 5332; in Mindoro Strait; Apo Light bearing S. 66° W., 18.2 miles distant (lat. 12°47′15″ N., long. 120°41′00″ E.); 1,362 meters; bottom temperature 3.44° C.; green mud; December 12, 1909. One specimen.

Station 5608; Gulf of Tomini, Celebes; Binang Unang peak bearing S. 87° E., 19 miles distant (lat. 0°08′00″ S., long. 121°19′00″ E.); 1,991 meters; bottom temperature 2.39° C.; gray mud; November 18, 1909. One specimen.

Remarks.—The specimen from station 5608 is 25 mm. in diameter, and that from station 5332 is 23 mm. in diameter. The number of plates in the specimen 25 mm. in diameter (station 5608) is 5–6 ambulacral plates on the oral, 11–12 on the aboral side, and the same numbers respectively in the interambulacra. In the specimen 23 mm. in diameter (station 5332) there are 5–6 ambulacral plates on the oral, 7–8 on the aboral side, and the same numbers respectively in the interambulacra. Both specimens have only three plates in a series on the peristome.

The tridentate pedicellariae are characteristic in having a distinct arc under the articular surface (fig. 3, *a*), a character otherwise known only in *Sperosoma durum* Döderlein. In the smaller specimen there

are numerous ophicephalous pedicellariae (fig. 3, *d*) also resembling those of *S. durum*. In the larger specimen only a single ophicephalous pedicellaria was found, which looks rather different (fig. 3, *b*)—not like those of *S. durum*.

The smaller specimen is a beautiful purple, the larger a light grayish.

These two small specimens cannot with certainty be referred to any of the species known from the Malay Archipelago. It can only be seen with certainty that they belong to the genus *Sperosoma*, since some of the oral ambulacral plates are divided into two in the way typical of this genus. It is not very likely that both belong to one

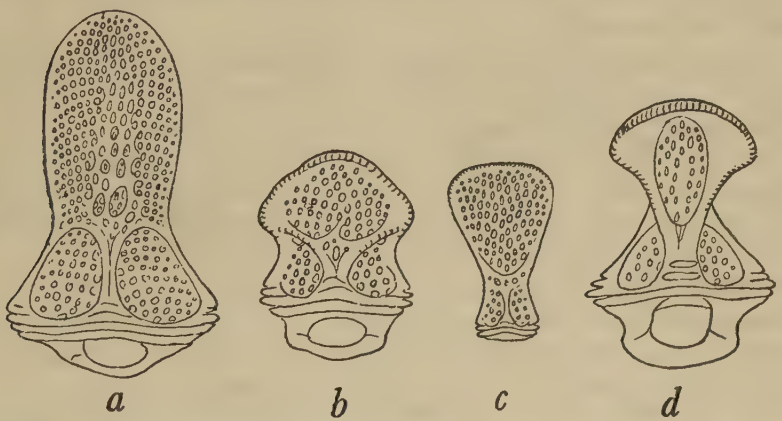

FIGURE 3.—Valves of pedicellariae of *Sperosoma* sp., young: *a–c*, Specimen from station 5608; *d*, specimen from station 5332. *a*, Valve of tridentate pedicellaria; possibly the edge of the blade not yet fully developed (without serrations); *b* and *d*, Valves of ophicephalous pedicellariae; *c*, valve of triphyllous pedicellaria. All × 80.

and the same species, in spite of the fact that both have the peculiar arc under the valves of the tridentate pedicellariae; the different shape of the ophicephalous pedicellariae would seem to preclude the idea of their belonging to the same species. That one of them may be identical with *S. durum* is quite possible; but the fact that the small specimen, the ophicephalous pedicellariae of which resemble those of *S. durum*, has the fewer number of aboral ambulacral plates, whereas *S. durum* has, when adult, about three times as many aboral as oral ambulacral plates, is not in favor of such identity. That *S. durum* is known hitherto only from the Indian Ocean off the African coast—only one specimen is known—would not be any serious objection to their identity.

On the whole, a much richer material, with series of intermediate sizes, will be necessary for identifying with certainty these young specimens, or for deciding whether they perhaps represent hitherto unknown species.

Genus HYGROSOMA Mortensen

HYGROSOMA HOPLACANTHA (Wyville Thomson)

Phormosoma hoplacantha A. Agassiz, *Challenger* Reports, Zoology, vol. 3, pt. 9, Echinoidea, p. 101, pl. 11; pl. 12; pl. 12a, figs. 10–13, 1881.

Hygrosoma hoplacantha Mortensen, *Ingolf* Echinoidea, pt. 1, p. 59, 1903; Monograph of the Echinoidea, vol. 2, p. 208, pl. 18, fig. 1; pl. 19, fig. 1; pl. 20, figs. 1, 2; pl. 78, fig. 2, 1935.

Echinosoma hoplacantha A. Agassiz and H. L. Clark, Hawaiian and other Pacific Echini, Echinothuridae, p. 161, 1909.

Localities.—Station 5116; Verde Island passage; Sombrero Island bearing N. 69° E., 2.5 miles distant (lat. 13°41′00″ N., long. 120° 47′05″ E.); 366 meters; bottom temperature 10.11° C.; January 20, 1908. One specimen.

Station 5123; east coast Mindoro; Malabrigo Light bearing N. 44° W., 32.5 miles distant (lat. 13°12′45″ N., long. 121°38′45″ E.); 517 meters; green mud; February 2, 1908. Two specimens.

Station 5281; China Sea, in the vicinity of southern Luzon; Malavatuan Island (N.) bearing S. 84° W., 4.3 miles distant (lat. 13°52′45″ N., long. 120°25′00″ E.); 367 meters; bottom temperature 10.22° C.; dark gray sand; July 18, 1908. Three specimens.

Station 5282; China Sea in the vicinity of southern Luzon; Malavatuan Island (N.) bearing S. 84° W., 6.2 miles distant (lat. 13°53′00″ N., long. 120°26′45″ E.); 453 meters; bottom temperature 8.56° C.; dark gray sand; July 18, 1908. Three specimens.

Station 5283; China Sea, in the vicinity of southern Luzon; Malavatuan Island (N.) bearing N. 64° W., 8.75 miles distant (lat. 13°48′30″ N., long. 120°28′40″ E.); 512 meters; bottom temperature 8.22° C.; dark gray sand; July 18, 1908. Four specimens.

Station 5424; Jolo Sea; Cagayan Island (S.) bearing S. 11° W., 3.4 miles distant (lat. 9°37′05″ N., long. 121°12′37″ E.); 622 meters; bottom temperature 10.22° C.; coral sand; March 31, 1909. One specimen.

Station 5428; in the vicinity of eastern Palawan; Thirtieth of June Island bearing N. 62° W., 19.5 miles distant (lat. 9°13′00″ N., long. 118°51′15″ E.); 2,020 meters; gray mud; April 3, 1909. One specimen.

Station 5445; east coast of Luzon; Atalaya Point, Batag Island, bearing S. 64° E., 3.6 miles distant (lat. 12°43′05″ N., long. 125° 01′00″ E.); 700 meters; bottom temperature 6.83° C.; green mud and sand; June 3, 1909. Ten specimens.

Station 5450; eastern coast of Luzon; East Point, Batan Island, bearing S. 36° E., 9.2 miles distant (lat. 13°23′15″ N., long. 124° 00′30″ E.); 734 meters; bottom temperature 5.72° C.; green mud and coral; June 4, 1909. One specimen.

Station 5487; between Leyte and Mindanao; San Ricardo Point, Panaon Island, bearing S. 50° E., 11.2 miles distant (lat. 10°02′45″ N., long. 125°05′33″ E.); 1,338 meters; bottom temperature 11.28° C.; green mud; July 31, 1909. One specimen.

Station 5488; between Leyte and Mindanao; San Ricardo Point, Panaon Island, bearing S. 59° E., 9 miles distant (lat. 10°00′00″ N., long. 125°06′45″ E.); 1,411 meters; bottom temperature 11.28° C.; green mud; July 31, 1909. One young specimen, and fragments of a larger one.

Station 5492; between Leyte and Mindanao; Diuata Point (W.) bearing S. 45° W., 15.2 miles distant (9°12′45″ N., long. 125°20′ 00″ E.); 1,344 meters; bottom temperature 11.28° C.; gray mud; August 1, 1909. Three specimens.

Station 5494; between Leyte and Mindanao; Diuata Point (N.) bearing N. 74° W., 4.2 miles distant (lat. 9°06′30″ N., long. 125° 18′40″ E.); 1,239 meters; bottom temperature 11.83° C.; green mud and sand; August 2, 1909. Twelve specimens.

Station 5513; in the vicinity of northern Mindanao; Camp Overton Light bearing S. 67° E., 10.3 miles distant (lat. 8°16′45″ N., long. 124°02′48″ E.); 923 meters; bottom temperature 11.56° C.; gray mud and fine sand; August 7, 1909. Two specimens.

Station 5566; between Jolo and Tawi Tawi; Dammi Island (N.) bearing S. 67° W., 6.8 miles distant (lat. 5°52′12″ N., long. 120° 31′00″ E.); 446 meters; bottom temperature 11.28° C.; fine sand and shells; September 21, 1909. One specimen.

Station 5575; north of Tawi Tawi; Mt. Dromedario, Tawi Tawi, bearing S. 16° W., 19.2 miles distant (lat. 5°28′30″ N., long. 120° 02′27″ E.); 576 meters; bottom temperature 11.28° C.; coral and sand; September 23, 1909. Six specimens.

Station 5585; in the vicinity of Sibuko Bay, Borneo; Sipadan Island (M.) bearing S. 89° W., 12 miles distant (lat. 4°07′00″ N., long. 118°49′54″ E.); 870 meters; bottom temperature 5.06° C.; gray mud; September 28, 1909. One specimen.

Station 5586; in the vicinity of Sibuko Bay, Borneo; Sipadan Island (M.) bearing W. 9.4 miles distant (lat. 4°06′50″ N., long. 118°47′20″ E.); 634 meters; bottom temperature 6.67° C.; gray mud; September 28, 1909. Three specimens.

Station 5587; in the vicinity of Sibuko Bay, Borneo; Sipadan Island (W.) bearing S. 12° E., 3.8 miles distant (lat. 4°10′35″ N., long. 118°37′12″ E.); 759 meters; bottom temperature 5.72° C.; green mud, sand, and coral; September 28, 1909. One specimen.

Station 5601a; Gulf of Tomini, Celebes; Limbe Island (NE.) bearing N. 20.7 miles distant (lat. 1°13′10″ N., long. 125°17′05″ E.); 1,398 meters; sand, globigerinae, and pteropods; November 13, 1909. Two specimens.

Station 5605; Gulf of Tomini, Celebes; Dodepo Island (W.) bearing N. 14° W., 5.9 miles distant (lat. 0°21′33″ N., long. 121°34′10″ E.); 1,183 meters; November 16, 1909. Three specimens.

Station 5606; Gulf of Tomini, Celebes; Dodepo Island (W.) bearing N. 3° W., 10.8 miles distant (lat. 0°16′28″ N., long. 121°33′30″); 1,525 meters; green mud; November 17, 1909. One specimen.

Station 5608; Gulf of Tomini, Celebes; Binang Unang Island peak bearing S. 87° E., 19 miles distant (lat. 0°08′00″ S., long. 121°19′00″ E.); 1,991 meters; bottom temperature 2.39° C.; gray mud; November 18, 1909. One specimen.

Station 5609; Gulf of Tomini, Celebes; Binang Unang Island (N.) bearing N. 80° E., 21 miles distant (lat. 0°11′00″ S., long. 121°16′00″ E.); 1,996 meters; bottom temperature 2.39° C.; green mud; November 18, 1909. One young specimen, the identification of which is not beyond doubt.

Station 5638; in the vicinity of Bouro Island; Tifu Bay entrance (W.) bearing N. 17° E., 3.2 miles distant (lat. 3°47′15″ S., long. 126°23′40″ E.); 945 meters; fine gray sand; December 10, 1909. One specimen.

Station 5650; Gulf of Boni, Celebes; Lamulu Point bearing N. 5° W., 12.5 miles distant (lat. 4°53′45″ S., long. 121°29′00″ E.); 987 meters; green mud; December 17, 1909. Two specimens.

Station 5656; Gulf of Boni, Celebes; Olang Point bearing N. 67° W., 14.5 miles distant (lat. 3°17′40″ S., long. 120°36′45″ E.); 871 meters; gray mud; December 19, 1909. Two specimens.

Remarks.—Most of the specimens are in poor, or very poor, condition. Only one of the largest specimens, 200 mm. in diameter — none exceed that size — from station 5568 and a small specimen from station 5683 have each a couple of oral spines with the hoof preserved. In the latter a small barnacle of the genus *Scalpellum* is attached to one of them.

Only a few of the specimens have kept their original dark purple, or black, color. Most of them are yellowish, though I have little doubt that these were originally dark colored also but have lost their color gradually.

In a young specimen 21 mm. in diameter from station 5492 I have found a couple of ophicephalous pedicellariae. Unfortunately no tridentate pedicellariae are found in this specimen, but a comparison with other young specimens, slightly larger, seems to leave no room for doubt that it is really a young *Hygrosoma hoplacantha*, so that also this species may have ophicephalous pedicellariae when young, and that will then probably hold good for all the species of *Hygrosoma*, though as yet not known in *H. luculentum*. It is noteworthy

that these ophicephalous pedicellariae are quite different from those of *Tromikosoma*, having no neck, and with the stalk simple, not tube-shaped as in the latter genus.

The larger specimens are conspicuously pentagonal.

The contents of the intestinal canal of the larger specimens was found to be mainly bits of land plants.

HYGROSOMA LUCULENTUM (A. Agassiz)

Phormosoma luculentum A. Agassiz, *Challenger* Reports, Zoology, vol. 3, pt. 9, Echinoidea, p. 97, pl. 9; pl. 10; pl. 10a, figs. 3–7; pl. 39, fig. 8; pl. 40, figs. 31–36; pl. 44, figs. 25–27, 1881.

Hygrosoma luculentum Mortensen, *Ingolf* Echinoidea, pt. 1, pp. 59, 64, pl. 12, fig. 20; pl. 13, figs. 14, 16, 1903. — Döderlein, Wiss. Ergebn. Tiefsee-Exped., vol. 5, Lief. 2, p. 143, pl. 17, fig. 2; pl. 39, fig. 1, 1906.—Koehler, *Investigator* Echinoidea, pt. 3, p. 36, pl. 24, fig. 1, 1927.—Mortensen, Monograph of the Echinoidea, vol. 2, p. 215, pl. 21; pl. 22; pl. 78, figs. 22, 23, 1935.

Echinosoma luculentum A. Agassiz and H. L. Clark, Hawaiian and other Pacific Echini, Echinothuridae, p. 163, 1909.

Localities.—Station 5447; east coast of Luzon; San Miguel Point bearing S. 7° W., 3.5 miles distant (lat. 13°28′00″ N., long. 123°46′18″ E.); 567 meters; bottom temperature 7.39° C.; green mud; June 4, 1909. One specimen.

Station 5506; off northern Mindanao; Macabalan Point Light, Mindanao, bearing S. 41° E., 12.2 miles distant (lat. 8°40′00″ N., long. 124°31′45″ E.); 479 meters; bottom temperature 11.83° C.; green mud; August 5, 1909. One specimen.

Station 5512; in the vicinity of northern Mindanao; Camp Overton Light bearing S. 76° E., 14 miles distant (lat. 8°16′02″ N., long. 123°58′26″ E.); 813 meters; bottom temperature 11.56° C.; gray mud and fine sand; August 7, 1909. One specimen.

Remarks.—The specimens from stations 5506 and 5512, both of which are small, should perhaps rather be referred to *H. hoplacantha*, neither having the typical large broad-valved pedicellariae so characteristic of *luculentum*. But there is, in the former at least, one pedicellaria intermediate between the coarse and the slender form, and in the latter the spines near the apical system appear to have been skin clad, which is another character of *luculentum*. But on the whole *luculentum* is so closely related to *hoplacantha* that it may be doubted even whether they are really different species, and unless very typically developed and well-preserved specimens are at hand it will probably not be possible really to distinguish between them. When the typical coarse pedicellariae are present, as in the specimen from station 5447, there is, of course, no difficulty in distinguishing them.

Like *H. hoplacantha*, this species was found to feed mainly on land plants washed out to sea and sunk to the bottom.

Genus ARAEOSOMA Mortensen

ARAEOSOMA CORIACEUM (A. Agassiz)

PLATE 1, FIGURE 1

Asthenosoma coriaceum A. AGASSIZ, *Challenger* Reports, Zoology, vol. 3, pt. 9, Echinoidea, p. 88, pl. 17a, figs. 5–7, 1881.

Araeosoma coriaceum MORTENSEN, *Ingolf* Echinoidea, pt. 1, p. 53, pl. 11, fig. 15; pl. 12, fig. 27; pl. 14, fig. 5, 1903; Monograph of the Echinoidea, vol. 2, p. 241, pl. 32; pl. 33; pl. 34; pl. 79, figs. 10–15, 1935.

Locality.—Station 5446; eastern coast of Luzon; Atalaya Point, Batag Island, bearing S. 64° E., 5.3 miles distant (lat. 12°43′51″ N., long. 124°59′18″ E.); 540 meters; green mud; June 3, 1909. One specimen.

Remarks.—That this specimen should be referred to *Araeosoma coriaceum* seems rather certain. It is this specimen that is figured in my Monograph on plates 33 and 34. Some minor differences in regard to the pedicellariae are probably only apparent. I do not find in this specimen any pedicellariae exactly like the form figured in my *Ingolf* report (pl. 14, fig. 5), but the smaller tridentate ones are otherwise exactly as in the type of *coriaceum*. Then I find in the present specimen a large form of involute pedicellariae (pl. 1, fig. 1) that has not been observed in the typical *coriaceum*. These two negative characters cannot, of course, prove the *Albatross* specimen to be a different species, there being no other characters to distinguish them. It may be particularly mentioned that the hoof of the oral primary spines is small and broad in the *Albatross* specimen as it is in the type.

The color of the present specimen is a uniform dark gray.

The aboral plates are straight, as in one of the original specimens.

Agassiz in his preliminary report on the *Challenger* Echinoidea gave this species from station 204 off the Philippines (lat. 12°43′ N., long. 122°10′ E.) in 100 fathoms, whereas in the final report he gave it only from off the Fiji Islands. The specimen from station 204 seems to have disappeared. The finding of the species by the *Albatross* in the Philippine Sea makes it probable that the *Challenger* specimen from this region may have been a true *A. coriaceum*.

The intestine of this specimen, which I have stuffed in order to make it assume its real shape, proved to contain mainly bits of land plants, though also a little bottom material.

ARAEOSOMA TESSELLATUM (A. Agassiz)

Asthenosoma tessellatum A. AGASSIZ, *Challenger* Reports, Zoology, vol. 3, pt. 9, Echinoidea, p. 88, pl. 12a, figs. 14, 15; pl. 19a, fig. 1; pl. 19b, 1881.

Araeosoma tessellatum MORTENSEN, *Ingolf* Echinoidea, pt. 1, pp. 54, 64, pl. 13, figs. 5, 6; pl. 14, fig. 15, 1903.—DE MEIJERE, *Siboga* Echinoidea, p. 35; pl. 13,

figs. 153–157, 1904.—Mortensen, Monograph of the Echinoidea, vol. 2, p. 246, pl. 36; pl. 37; pl. 38, figs. 1, 2; pl. 39; pl. 81, figs. 1–22, 1935.

Localities.—Station 5135; in the vicinity of Jolo (Sulu); Jolo Light bearing S. 46° W., 11.9 miles distant (lat. 6°11′50″ N., long. 121°08′20″ E.); 294 meters; bottom temperature 14.17° C.; fine coral sand; February 7, 1908. Two specimens.

Station 5445; eastern coast of Luzon; Atalaya Point, Batag Island, bearing S. 56° E., 5.3 miles distant (lat. 12°44′42″ N., long. 124°59′50″ E.); 700 meters; bottom temperature 6.83° C.; green mud and sand; June 3, 1909. One specimen.

Station 5452; off the east coast of Luzon; Legaspi Light bearing S. 38° W., 3 miles distant (lat. 13°11′54″ N., long. 123°47′10″ E.); 201 meters; June 7, 1909. One specimen.

Station 5565; between Jolo (Sulu) and Tawi Tawi; Dammi Island (N.) bearing S. 69° W., 6 miles distant (lat. 5°51′42″ N., long. 120°30′30″ E.); 444 meters; bottom temperature 11.28° C.; sand and pteropod shells; September 21, 1909. One specimen.

Remarks.—The specimen from station 5445 is a small one, 45 mm. in diameter. Only very few pedicellariae, of the small tridentate and the triphyllous forms, are preserved, and all the primary spines are broken. But it is in general so very like some specimens of corresponding size from off Zamboanga that I dredged in 1914, which are certainly referable to *A. tessellatum*, that I can have no doubt that this specimen also is a young *A. tessellatum*.

ARAEOSOMA TESSELLATUM var. CARINATUM Mortensen

Araeosoma tessellatum, var. *carinatum* Mortensen, Vid. Medd. Dansk Naturh. Foren., vol. 98, p. 163, 1934; Monograph of the Echinoidea, vol. 2, p. 250, pl. 40, figs. 1, 2; pl. 81, fig. 23, 1935.

Locality.—Station 5290; China Sea, in the vicinity of southern Luzon; Matocot Point bearing S. 50° E., 3.1 miles distant (lat. 13°40′09″ N., long. 120°59′30″ E.); 391 meters; lava and gravel; July 22, 1908. Two specimens.

Remarks.—It is quite probable that these specimens rather represent a separate species, but from the material available this can scarcely be decided. The peristomial plates and the ambulacral plates of the oral side are more numerous than in the typical *tessellatum*, but there are transitions in this regard. The only reliable difference appears to be the existence of a longitudinal keel in the valves of the small tridentate pedicellariae, such a keel not being found in typical *tessellatum*. But this would seem too unimportant for a species character. Dactylous pedicellariae were not found. It will then be preferable for the present to designate this form only as a variety of *A. tessellatum*.

ARAEOSOMA PARVIUNGULATUM Mortensen

Araeosoma parviungulatum Mortensen, Vid. Medd. Dansk Naturh. Foren., vol. 98, p. 164, 1934; Monograph of the Echinoidea, vol. 2, p. 254, pl. 43; pl. 44; pl. 77, figs. 1–8, 1935.

Locality.—Station 5645; in Buton Strait; North Island (NE.) bearing S. 10° W., 1.6 miles distant (lat. 5°29′06″ S., long. 122°36′06″ E.); 377 meters; December 16, 1909. One specimen.

Remarks.—A full description of this species, with figures, is given in the Monograph. It appears to be most nearly related to *A. coriaceum*, from which, however, it is easily distinguished, particularly by the much broader ambulacra and the much smaller hoofs of the oral primary spines. Also the pedicellariae are somewhat different.

The intestinal canal was found to contain mainly bits of land plants.

ARAEOSOMA OWSTONI var. NUDUM Mortensen

Plate 1, Figures 2, 3

Araeosoma owstoni, var. *nudum* Mortensen, Vid. Medd. Dansk Naturh. Foren., vol. 98, p. 164, 1934; Monograph of the Echinoidea, vol. 2, p. 266, pl. 51; pl. 52; pl. 77, figs. 9–12; pl. 80, figs. 1, 2, 1935.

Localities.—Station 5135; in the vicinity of Jolo (Sulu); Jolo Light bearing S. 46° W., 11.9 miles distant (lat. 6°11′50″ N., long. 121°08′20″ E.); 294 meters; bottom temperature 14.11° C.; fine coral sand; February 7, 1908. Two specimens.

Station 5311; China Sea, in the vicinity of Hong Kong (lat. 21°33′00″ N., long. 116°15′00″ E.); 161 meters; coarse sand and shells; November 4, 1908. One specimen.

Station 5314; China Sea, in the vicinity of Hong Kong (lat. 21°41′00″ N., long. 116°46′00″ E.); 223 meters; sand and broken shells; November 5, 1908. One specimen.

Station 5446; eastern coast of Luzon; Atalaya Point, Batag Island, bearing S. 64° E., 5.3 miles distant (lat. 12°43′51″ N., long. 124°59′18″ E.); 540 meters; green mud; June 3, 1909. One specimen, the type.

Remarks.—This form differs from typical *A. owstoni* only in having the aboral side much barer, its general appearance being thus conspicuously different from the latter. It seems therefore desirable to distinguish it as a separate variety, in spite of the fact that there appear to be no other tangible differences. The fact that this form occurs also off the coasts of Annam indicates that it is the more southern representative of the typical *A. owstoni* of Japanese seas.

One of the specimens from station 5135 is rather perplexing. It has more numerous tubercles (spines) on the aboral side than usual, and the pedicellariae show some peculiarity in the existence of a large

1, Valve of large, involute, tridentate pedicellaria of *Araeosoma coriaceum* (A. Agassiz). × 27.
2, Valve of large, involute, tridentate pedicellaria of *Araeosoma owstoni* var. *nudum* Mortensen. Hybrid (?). × 33.
3, Large, involute, tridentate pedicellaria of *Araeosoma owstoni* var. *nudum* Mortensen Hybrid (?). × 17.

involute form of tridentate pedicellariae (pl. 1, figs. 2, 3) so closely resembling that of *A. coriaceum* that one might be inclined to think this specimen rather to be referable to the latter species. As a matter of fact, I believe this specimen to be a hybrid between *A. coriaceum* and *A. owstoni* var. *nudum*. Since the two forms evidently occur in the same area (the China Sea) there is so far nothing to prevent them from forming hybrids. The unfortunate fact that there are no dactylous pedicellariae to be found in the specimen under consideration prevents reaching a definite conclusion. The dactylous pedicellariae of *A. owstoni* and *A. coriaceum* are very different—3-valved and of a very primitive type in the former, 5-valved and of a highly finished type in the latter.

Genus HAPALOSOMA Mortensen

HAPALOSOMA PELLUCIDUM (A. Agassiz)

Asthenosoma pellucidum A. Agassiz, *Challenger* Reports, Zoology, vol. 3, pt. 9, Echinoidea, p. 85, pl. 18, figs. 1–6; pl. 18a, figs. 14–17; pl. 19, figs. 1–6, 1881.
Hapalosoma pellucidum Mortensen, *Ingolf* Echinoidea, pt. 1, pp. 55, 64, pl. 11, fig. 19; pl. 12, figs. 8–10, 14; pl. 13, figs. 20, 24, 25, 1903; pt. 2, p. 21, 1907; Monograph of the Echinoidea, vol. 2, p. 271, pl. 53, figs. 1–11; pl. 54, figs. 1, 2; pl. 83, figs. 1, 2, 4–10, 14, 16, 18, 1935.
Araeosoma pellucidum A. Agassiz and H. L. Clark, Hawaiian and other Pacific Echini, Echinothuridae, 1909, p. 181.

Locality.—Station 5135; in the vicinity of Jolo (Sulu); Jolo Light bearing S. 46° W., 11.9 miles distant (lat. 6°11′50″ N., long. 121°08′20″ E.); 294 meters; bottom temperature 14.11° C.; fine coral sand; February 7, 1908. Two specimens.

Remarks.—There can be no doubt that this beautiful and, because of its banded spines and its pedicellariae, easily recognizable species is closely related to the forms in the genus *Araeosoma*, representing a special branch of that genus, as evidenced by its remarkably transformed dactylous pedicellariae. Still, I cannot agree with Agassiz and Clark in simply referring it to *Araeosoma*. Nothing at all is gained by referring it to the large genus *Araeosoma*, within which, together with another species from the Japanese seas hitherto incorrectly identified with *H. pellucidum*, it must form a group of its own. I shall, therefore, have to maintain the genus *Hapalosoma*.

Genus ASTHENOSOMA Grube

ASTHENOSOMA VARIUM Grube

Asthenosoma varium Grube, Jahrb. schles. Ges. vaterl. Cultur, vol. 45, p. 42, 1868.—Mortensen, Monograph of the Echinoidea, vol. 2, p. 280, pls. 55–58; pl. 61, figs. 1–6; pl. 62, figs. 1, 2; pl. 82, figs. 1–3, 5, 6, 9–14, 1935.
Asthenosoma grubei A. Agassiz, *Challenger* Reports, Zoology, vol. 3, pt. 9, Echinoidea, p. 82, pls. 15–17, 1881.

Asthenosoma urens SARASIN, Ergebn. naturw. Forsch. Ceylon, vol. 1, pt. 3, 1888.
Asthenosoma heteractis BEDFORD, Proc. Zool. Soc. London, 1900, p. 278, pl. 21, fig. 2.

Localities.—Station 5136; in the vicinity of Jolo (Sulu); Jolo Light bearing S. 37° E., 0.7 mile distant (lat. 6°04′20″ N., long. 120°59′20″ E.); 40 meters; sand and shells; February 14, 1908. One specimen.

Station 5138; in the vicinity of Jolo; Jolo Light bearing S. 19° E., 2.5 miles distant (lat. 6°06′00″ N., long. 120°58′50″ E.); 35 meters; sand and coral; February 14, 1908. One specimen.

Station 5139; in the vicinity of Jolo; Jolo Light bearing S. 51° W., 3.6 miles distant (lat. 6°06′00″ N., long. 121°02′30″ E.); 36 meters; coral sand; February 14, 1908. One specimen.

Station 5141; in the vicinity of Jolo; Jolo Light bearing S. 17° E., 5.5 miles distant (lat. 6°09′00″ N., long. 120°58′00″ E.); 53 meters; coral sand; February 15, 1908. One specimen.

Station 5142; in the vicinity of Jolo; Jolo Light bearing S. 50° W., 3.9 miles distant (lat. 6°06′10″ N., long. 121°02′40″ E.); 38 meters; coral sand and shells; February 15, 1908. Two specimens.

Station 5144; in the vicinity of Jolo; Jolo Light bearing S. 50° W., 3.4 miles distant (lat. 6°05′00″ N., long. 121°02′15″ E.); 35 meters; coral sand; February 15, 1908. Two specimens.

Station 5146; Jolo (Sulu) Archipelago, in the vicinity of Siasi; Sulade Island (E.) bearing N. 18° W., 3.4 miles distant (lat. 5°46′40″ N., long. 120°48′50″ E.); 44 meters; coral sand and shells; February 16, 1908. One specimen.

Station 5147; Jolo Archipelago, in the vicinity of Siasi; Sulade Island (E.) bearing N. 3° E., 8.4 miles distant (lat. 5° 41′40″ N., long. 120°47′10″ E.); 38 meters; coral sand and shells; February 16, 1908. Two specimens.

Station 5148; Jolo Archipelago, in the vicinity of Siasi; Sirun Island (N.) bearing S. 80° W., 3.8 miles distant (lat. 5°35′40″ N., long. 120°47′30″ E.); 31 meters; coral sand; February 16, 1908. Twelve specimens.

Station 5149; in the vicinity of Siasi; Sirun Island (W.) bearing N. 39° E., 2.4 miles distant (lat. 5°33′00″ N., long. 120°42′10″ E.); 18 meters; coral and shells; February 18, 1908. Two specimens.

Station 5156; Tawi Tawi group, Jolo Archipelago; Tinakta Island (N.) bearing S. 77° W., 3.4 miles distant (lat. 5°12′50″ N., long. 119°55′55″ E.); 33 meters; fine sand and shells; February 21, 1908. One specimen.

Station 5218; between Burias and Luzon; Anima Sola Island (E.) bearing N. 10° W., 2 miles distant (lat. 13°11′15″ N., long. 123° 02′ 45″ E.); 37 meters; coarse sand; April 22, 1908. One small specimen.

Remarks.—That the forms described under the names *Asthenosoma grubei*, *A. urens*, and *A. heteractis* are simply synonyms of *A. varium*, as has repeatedly been suggested, can no longer be doubted.

ASTHENOSOMA IJIMAI Yoshiwara

Asthenosoma ijimai YOSHIWARA, Annot. Zool. Japon., vol. 1, p. 8, pl. 2, figs. 8–12, 1897.—MORTENSEN, Ann. Mag. Nat. Hist., ser. 7, vol. 14, p. 87, pl. 3, figs. 1, 2; pl. 5, figs. 1–3, 10, 12–14, 1904; Monograph of the Echinoidea, vol. 2, p. 288, pl. 63; pl. 64; pl. 65, figs. 1, 2, 1935.

Localities.—Station 5136; in the vicinity of Jolo (Sulu); Jolo Light bearing S. 37° E., 0.7 mile distant (lat. 6°04′20″ N., long. 120°59′20″ E.); 40 meters; sand and shells; February 14, 1908. One large specimen.

Station 5141; in the vicinity of Jolo; Jolo Light bearing S. 17° E., 5.5 miles distant (lat. 6°09′00″ N., long. 120°58′00″ E.); 53 meters; coral sand; February 15, 1908. One small specimen.

Station 5142; in the vicinity of Jolo; Jolo Light bearing S. 50° W., 3.9 miles distant (lat. 6°06′10″ N., long. 121°02′40″ E.); 38 meters; coral sand and shells; February 15, 1908. One specimen.

Station 5482; in the vicinity of Surigao Strait; Cabugan Grande Island (N.) bearing N. 87° W., 4.5 miles distant (lat. 10°27′30″ N., long. 125°18′00″ E.); 122 meters; broken shells, sand, and green mud; July 30, 1909. One large specimen.

Remarks.—This species having been hitherto recorded only from the Sagami Sea, Japan, it is of considerable zoogeographical interest that it has been found in the Philippine seas by the *Albatross*. I have also myself taken it there, off Jolo, in 1914, and later, in 1922, at the Kei Islands, which indicates that it will eventually be found to be widely distributed in the Malay Archipelago.

ASTHENOSOMA DILATATUM Mortensen

Asthenosoma dilatatum MORTENSEN, Monograph of the Echinoidea, vol. 2, p. 292, pl. 65, figs. 3, 4; pl. 82, fig. 4; pl. 83, figs. 15–17, 1935.

Locality.—Station 5142; in the vicinity of Jolo (Sulu); Jolo Light bearing S. 50° W., 3.9 miles distant (lat 6° 06′ 10″ N., long. 121° 02′ 40″ E.); 38 meters; coral sand and shells; February 15, 1908. One specimen.

Remarks.—This is a very young specimen, only 10 mm. in diameter. It differs from the type specimen in the much darker color of its spines, a difference that may, however, be due simply to preservation. The specimen, which has apparently been dried out, gives the impression of having assumed a darker color through having been preserved together with comatulids. As is explained in the reference given, the numbers of its coronal plates differ remark-

ably from those of the type, so it is possible that it is really a different species; but as both the present specimen and the type are young it is impossible to decide whether this difference, and the difference in color, may perhaps in reality be specific differences. The highly characteristic pedicellariae, with delicate spoon-shaped valves, are alike in both.

Order STIRODONTA

Family SALENIIDAE

Genus SALENOCIDARIS A. Agassiz

SALENOCIDARIS HASTIGERA (A. Agassiz)

Salenia hastigera A. Agassiz, *Challenger* Reports, Zoology, vol. 3, pt. 9, Echinoidea, p. 54, pl. 4, figs. 3–17, 1881; Panamic deep-sea Echini, pl. 20, fig. 8, 1904.
Salenocidaris hastigera Mortensen, Monograph of the Echinoidea, vol. 2, p. 360, pl. 56, figs. 1–2; pl. 85, figs. 5–7, 31–33; pl. 86, figs. 17–20, 1935.

Locality.—Station 5601; Gulf of Tomini, Celebes; Limbe Island (NE.) bearing N., 20.7 miles distant (lat. 1°13′10″ N., long. 125° 17′05″E.); 1,398 meters; sand, globigerinae, and pteropods; November 13, 1909. One specimen.

Remarks.—In their Hawaiian and other Pacific Echini published in 1908, on page 58, Agassiz and Clark declare *Salenocidaris hastigera* identical with *S. profundi* (Duncan). This undoubtedly holds good for the Atlantic specimens identified as *S. hastigera,* but not for the specimens from the Indo-Malayan region, which are distinguished from the Atlantic form particularly by ocular I being exsert, even in the adult, whereas in the Atlantic *profundi* ocular I is broadly insert—except for the variety *occlusa* Mortensen, which has ocular I exsert like *hastigera*, from which species it differs, however, in other characters so as to be decidedly the nearer related to *profundi.*

Since in the preliminary report on the *Challenger* echinoids Agassiz mentions under his *Salenia hastigera* first the station 195, Banda Sea, the specimen from that station must be taken to represent the type specimen of *hastigera*, and the name *hastigera* is thus to be preserved for the form from the Indo-Malayan region.

SALENOCIDARIS HASTIGERA var. ACUMINATA Mortensen

Salenocidaris hastigera, var. *acuminata* Mortensen, Vid. Medd. Dansk Naturh. Foren., vol. 98, p. 166, 1934; Monograph of the Echinoidea, vol. 2, p. 363, pl. 85, fig. 14; pl. 86, figs. 11–13, 1935.

Locality.—Station 5614; Molucca Passage; Tifori Island (C.) bearing N. 19° E., 30.5 miles distant (lat. 0°31′00″ N., long. 125°58′45″ E.); 2,010 meters; gray mud, sand, and globigerinae; November 22, 1909. One specimen.

Remarks.—This specimen, which measures 9 mm. in horizontal diameter, differs from the typical *hastigera* in various points. The

ambulacral spines are constricted in their distal part, being thus somewhat pointed and also somewhat longer than usual. Genital pores have not yet appeared, whereas in typical *hastigera* they are already fully developed at a size of 8 mm. horizontal diameter, which fact would tend to indicate that it reaches a larger size than the typical *hastigera*. The tridentate (and quadridentate) pedicellariae are different from those of typical *hastigera*, broader and more like those of *profundi*. Quadridentate pedicellariae have not been observed in *hastigera*. In the characters of the test and of the spines it otherwise resembles *hastigera*, and also the color is the same—a light purplish on the test and secondary spines, the primary spines as well as the denuded test being white.

I rather think that this form will ultimately prove to represent a distinct species. But with only one specimen at hand one cannot determine how constant the characters pointed out are, so it would seem the better course for the present to designate it simply as a variety of *hastigera*, to which species it is, at any rate, closely related. To identify it merely as *hastigera* I do not think justifiable.

Family ARBACIIDAE

Genus PYGMAEOCIDARIS Döderlein

PYGMAEOCIDARIS PRIONIGERA (A. Agassiz)

Podocidaris prionigera A. Agassiz, *Challenger* Reports, Zoology, vol. 3, pt. 9, Echinoidea, p. 59, pl. 34, figs. 14, 15, 1881.

Pygmaeocidaris prionigera Döderlein, Wiss. Ergebn. Tiefsee-Exped., vol. 5, Lief. 2, p. 185, pl. 22, fig. 2; pl. 29, fig. 6; pl. 35, fig. 4; pl. 45, fig. 5, 1906.—Koehler, *Investigator* Echinoidea, pt. 3, p. 63, pl. 11, figs. 7–9, 1927.—Mortensen, Monograph of the Echinoidea, vol. 2, p. 553, pl. 87, figs. 27–35, 1935.

Locality.—Station 5608; Gulf of Tomini, Celebes; Binang Unang Island (peak) bearing S. 87° E., 19 miles distant (lat. 0°08′00″ S., long. 121°19′00″ E.); 1,991 meters; bottom temperature 2.39° C.; gray mud; November 18, 1909. One specimen.

Remarks.—This specimen, 13 mm. in diameter, is a good deal larger than the other four specimens hitherto known, the largest of which was only 9.5 mm. in diameter.

Though not in the very best condition—the spines are nearly all broken—this specimen has afforded a very welcome opportunity for adding to our knowledge of this highly interesting rare deep-sea echinoid.

Curiously, the contents of the intestine were found to be only bits of land plants, which must have been washed out from the shore and sunk to the bottom to form the vegetarian diet of this small deep-sea echinoid as well as of so many of the echinothurids.

Recalling that Döderlein found the primordial plate of this species to be divided into three parts lying in a vertical median series, as in the remarkable Triassic *Tiarechinus*, I must mention that in the one interambulacral area of the present specimen that has been denuded I find this plate undivided. The extraordinary fact that there are no genital pores in this specimen would seem to indicate that the genital pores are closed up after the shedding of the genital products. The idea that it might be a young individual with the genital pores not yet formed is opposed by the fact that genital pores are indicated as existing in the other smaller specimens known. But more extensive material is very much needed for settling this point.

Genus COELOPLEURUS L. Agassiz

COELOPLEURUS MACULATUS A. Agassiz and H. L. Clark

Coelopleurus maculatus A. Agassiz and H. L. Clark, Bull. Mus. Comp. Zool., vol. 51, p. 116, 1907; Hawaiian and other Pacific Echini, Salenidae, etc., p. 84, pl. 49, figs. 21–28; pl. 53, figs. 1–7; pl. 57, figs. 4–6, 1908.—Mortensen, Monograph of the Echinoidea, vol. 2, p. 631, pl. 67, fig. 4; pl. 68, figs. 1–3; pl. 69, figs. 10–16; pl. 88, figs. 26–29, 1935.

Localities.—Station 5217; between Burias and Luzon; Anima Sola Island bearing N. 42° W., 17.3 miles distant (lat. 13°20′00″ N., long. 123°14′15″ E.); 192 meters; bottom temperature 17.28° C.; coarse gray sand; April 22, 1908. One specimen.

Station 5415; between Cebu and Bohol; Lauis Point Light bearing N. 24° W., 7.2 miles distant (lat. 10°07′50″ N., long. 123°57′00″ E.); 161 meters; bottom temperature 16.89° C.; fine sand; March 24, 1909. Two specimens.

Station 5617; Dodinga Bay, Gillolo; Ternate Island (SE.) bearing S. 45° W., 7 miles distant (lat. 0°49′30″ N., long. 127°25′30″ E.); 239 meters; coral; November 27, 1909. One specimen.

Remarks.—In his "Catalogue of the Recent Sea-Urchins of the British Museum," published in 1925, on page 73, Dr. H. L. Clark comes to the conclusion that *Coelopleurus maculatus* is identical with *C. elegans* (Bell). I cannot agree with this. The valves of the ophicephalous pedicellariae of *C. elegans* are conspicuously different from those of *C. maculatus*, and since the ophicephalous pedicellariae within the genus *Coelopleurus* afford important specific differences, the character of the ophicephalous pedicellariae alone forbids regarding *elegans* and *maculatus* as identical. It appears also that *C. elegans* has none of the club-shaped secondary spines on the aboral side so characteristic of *C. maculatus*. On the whole it is clear that *C. elegans* stands much nearer to *C. maillardi* than to *C. maculatus*, and it is quite probable even that it is identical with *C. maillardi*, of which the name *elegans* would then be simply a synonym.

COELOPLEURUS MAILLARDI (Michelin)

Keraiophorus maillardi Michelin, Échinides et stellérides, *in* Maillard, Notes sur l'île de la Réunion, Annexe A, p. 2, pl. 14, 1862.

Coelopleurus maillardi A. Agassiz and H. L. Clark, Hawaiian and other Pacific Echini, Salenidae, etc., p. 84, pl. 49, fig. 34; pl. 53, figs. 8, 9, 1908.—Mortensen, Monograph of the Echinoidea, vol. 2, p. 627, pl. 67, fig. 3; pl. 68, fig. 4; pl. 69, figs. 1–3; pl. 88, figs. 22, 23, 1935.

Localities.—Station 5108; China Sea, off southern Luzon; Corregidor Light bearing N. 39° E., 22.5 miles distant (lat. 14°05′05″ N., long. 120°19′45″ E.); 23 meters; coral; January 15, 1908. One specimen.

Station 5413; between Cebu and Bohol; Lauis Point Light bearing N. 68° W., 10 miles distant (lat. 10°10′35″ N., long 124°03′15″ E.); 77 meters; March 24, 1909. One specimen.

Station 5483; between Samar and Leyte, in the vicinity of Surigao Strait; Cabugan Grande Island (N.) bearing N. 88° W., 5.7 miles distant (lat. 10° 27′ 30″ N., long. 125°19′15″ E.); 135 meters; sand and broken shells; July 30, 1909. Three specimens.

Remarks.—All the specimens are young and not very well preserved.

COELOPLEURUS LONGICOLLIS A. Agassiz and H. L. Clark

Coelopleurus maillardi (in part) A. Agassiz, *Challenger* Reports, Zoology, vol. 3, pt. 9, Echinoidea, p. 61, pl. 5; pl. 6; pl. 45, figs. 1–6, 1881.

Coelopleurus longicollis A. Agassiz and H. L. Clark, Hawaiian and other Pacific Echini, Salenidae, etc., p. 89, pl. 49, figs. 29–30; pl. 53, fig. 10, 1908.—Mortensen, Monograph of the Echinoidea, vol. 2, p. 619, pl. 67, figs. 7–9; pl. 88, figs. 19–21, 1935.

Locality.—Station 5392; between Samar and Masbate; Tubig Point bearing N. 49° E., 5 miles distant (lat. 12°12′35″ N., long. 124°02′48″ E.); 247 meters; green mud and sand; March 13, 1909. One specimen.

Remarks.—This specimen has been made the subject of a detailed description in my Monograph of the Echinoidea, the species having never before been duly described, since in the *Challenger* report it was mixed up with *C. maculatus* (both the species being erroneously identified as *C. maillardi* by Agassiz), and in the Hawaiian Echini only the pedicellariae were described and figured. The *Albatross* specimen thus is of considerable value, forming the base of the description of this species. That it is really identical with the *C. longicollis* of Agassiz and Clark would seem beyond doubt, the characteristic ophicephalous pedicellariae distinguishing this species from all other species of *Coelopleurus* except *C. australis* H. L. Clark, which is evidently very closely related to *C. longicollis*. In the absence of sufficient illustrations of *C. australis* it is not easy to judge of how close the relationship is. If they should ultimately turn out to be identical, it is the name *longicollis*, as the older, that must prevail, so it would not alter the name of the *Albatross* specimen.

Order AULODONTA

Family ASPIDODIADEMATIDAE

Genus PLESIODIADEMA Pomel

PLESIODIADEMA INDICUM (Döderlein)

Dermatodiadema indicum DÖDERLEIN, Zool. Anz., vol. 23, p. 21, 1901.—DE MEIJERE, *Siboga* Echinoidea, p. 46, pl. 3, fig. 23, 1904.—DÖDERLEIN, Wiss. Ergebn. Tiefsee-Exped., vol. 5, Lief, 2, p. 158, pl. 20, figs. 2, 3; pl. 41, fig. 2, 1906.—MORTENSEN, Vid. Medd. Dansk Naturh. Foren., vol. 76, p. 65, fig. 2, 1923.

Localities.—Station 5440; west coast of Luzon; San Fernando Point Light bearing N. 82° E., 23.1 miles distant (lat. 16°33′52″ N., long. 119°52′54″ E.); 314 meters; bottom temperature 11.78° C.; fine gray sand and globigerinae; May 10, 1909. One small specimen.

Station 5625; between Gillolo and Kayoa Islands; Kayoa Island (SE.) bearing S. 3° W., 6 miles distant (lat. 0°07′00″ N., long 127°28′00″ E.); 240 meters; gray mud and fine sand; November 29, 1909. Seven specimens.

Remarks.—The specimens from station 5625 are all of about the same size, about 30–32 mm. in horizontal diameter. None of them have any of the primary spines intact. In one of them the fairly well preserved aboral spines, which form the usual erect tuft, are of a light purplish color.

The specimen from station 5440 is only about 11 mm. in horizontal diameter and is by far the youngest specimen known. It already has spines on the buccal plates, and the genital pores have just appeared.

In some of the large specimens from station 5625 that I opened I found a good number of a very peculiar entoparasitic halacarid, which has recently been described by Dr. Karl Viets [6] under the name *Enterohalacarus minutipalpus*—the only case as yet known of a truly entoparasitic halacarid.

These specimens likewise disclosed the interesting fact that this deep-sea species prefers a vegetarian diet, the intestine being full of small bits of plants, apparently land plants, carried out to sea, where they have sunk to the bottom to form the staple food of deep-sea echinoids.

PLESIODIADEMA AMPHIGYMNUM (de Meijere)

Dermatodiadema amphigymnum DE MEIJERE, *Siboga* Echinoidea, p. 47, pl. 14, figs. 195–202, 1904.

Locality.—Station 5654; Gulf of Boni, Celebes; Cape Tabako bearing N. 17° E., 21.5 miles distant (lat. 3°42′00″ S., long. 120°45′50″ E.); 1,471 meters; December 18, 1909. One specimen.

[6] Zeitschr. für Parasitenk., vol. 10, pt. 2, pp. 210–216, 1938.

Remarks.—The specimen is only 10 mm. in horizontal diameter, though evidently adult, having large genital pores covered by long genital papillae. Although in very poor condition this specimen, the only one found since the *Siboga* expedition, is of considerable importance, affording proof that *P. amphigymnum* is not identical with the west American *P. horridum* as maintained by Agassiz and Clark. It is, no doubt, closely related to that species but differs markedly from it in the almost total absence of plates on the periproct, in the structure of the spines, and in the character of the ophicephalous pedicellariae. Also, it appears to reach only a much smaller size than the west American species.

Genus ASPIDODIADEMA A. Agassiz

ASPIDODIADEMA TONSUM A. Agassiz

Aspidodiadema tonsum A. Agassiz, *Challenger* Reports, Zoology, vol. 3, pt. 9, p. 66, pl. 8, figs. 1–9, 1881.—de Meijere, *Siboga* Echinoidea, p. 44, pl. 13, figs. 177–182, 1904.—Mortensen, The Danish Expedition to Siam 1899–1900, pt. 2, Echinoidea, p. 34, pl. 3, fig. 26; pl. 5, figs. 6, 31, 1904.—A. Agassiz and H. L. Clark, Hawaiian and other Pacific Echini, Salenidae, etc., p. 98, pl. 50, figs. 3–5, 1908.

Locality.—Station 5348; Palawan passage; Point Tabonan bearing S. 89° E., 33.5 miles distant (lat. 10°57′45″ N., long. 118°38′15″ E.); 685 meters; bottom temperature 13.56° C.; coral sand; December 27, 1908. Twenty specimens.

Remarks.—These specimens, ranging in size from 14 to 21 mm. in horizontal diameter, are all in rather poor condition and almost devoid of spines. In one of them, however, the basal 20 to 25 mm. of some of the aboral primary spines are preserved, enough to show that the spines of this species are curved as in other aspidodiadematids. One of the specimens shows distinct traces of a purplish color.

A specimen that was opened was found to contain only balls of mud, with Foraminifera and sponge spicules, in its intestinal canal. No ecto- or entoparasites were found with any of the specimens.

Family MICROPYGIDAE

Genus MICROPYGA A. Agassiz

MICROPYGA TUBERCULATA A. Agassiz

Micropyga tuberculata A. Agassiz, *Challenger* Reports, Zoology, vol. 3, pt. 9, p. 68, pl. 7, 1881.—de Meijere, *Siboga* Echinoidea, p. 59, pl. 14, fig. 215; pl. 15, figs. 216–231, 1904.—Döderlein, Wiss. Ergebn. Tiefsee-Exped., vol. 5, Lief. 2, p. 169, pl. 21, fig. 4; pl. 42, figs. 1–6; pl. 43, figs. 1–18; pl. 44, fig. 1, 1906.—H. L. Clark, Catalogue of the recent sea-urchins in the British Museum, p. 48, 1925.

Localities.—Station 5115; Verde Island passage; Sombrero Island bearing N. 49° E., 7.3 miles distant (lat. 13°37′11″ N., long. 120° 43′40″ E.); 622 meters; January 20, 1908. One specimen.

Station 5117; Verde Island passage; Sombrero Island bearing S. 17° E., 10.8 miles distant (lat. 13°52′22″ N., long. 120°46′22″ E.); 216 meters; January 21, 1908. One specimen.

Station 5118; Verde Island passage; Sombrero Island bearing S. 47° E., 10 miles distant (lat. 13°48′45″ N., long. 120°41′51″ E.); 291 meters; dark green mud; January 21, 1908. One specimen.

Station 5122; east coast of Mindoro; Malabrigo Light bearing N. 46° W., 20.6 miles distant (lat. 13°21′30″ N., long. 120°30′33″ E.); 402 meters; green mud; February 2, 1908. One specimen.

Station 5172; in the vicinity of Jolo (Sulu); Jolo Light bearing E. 24.75 miles distant (lat. 6°03′15″ N., long. 120°35′30″ E.); 581 meters; fine sand and shells; March 5, 1908. Three specimens.

Station 5198; in the vicinity of western Bohol; Baliscasag Island bearing S. 6° E., 10.25 miles distant (lat. 9°40′50″ N., long. 123° 39′45″ E.); 402 meters; bottom temperature 12.17° C.; green mud; April 9, 1908. Five specimens.

Station 5241; Pujada Bay and vicinity; Uanivan Island (N.) bearing S. 68° E., 3 miles distant (lat. 6°50′45″ N., long. 126°14′38″ E.); 393 meters; soft gray mud; May 14, 1908. Five specimens.

Station 5242; in the vicinity of Pujada Bay; Uanivan Island (N.) bearing S. 56° E., 4 miles distant (lat. 6°51′53″ N., long. 126° 14′10″ E.); 349 meters; bottom temperature 17.83° C.; soft gray mud. Three specimens.

Station 5243; in the vicinity of Pujada Bay; Uanivan Island (N.) bearing S. 66° E., 3.1 miles distant (lat. 6°50′55″ N., long. 126° 14′35″ E.); 398 meters; bottom temperature 17.56° C.; gray mud; May 15, 1908. Five specimens.

Station 5244; in the vicinity of Pujada Bay; Uanivan Island (N.) bearing S. 52°30′ E., 4 miles distant (lat. 6°52′05″ N., long. 126° 14′15″ E.); 313 meters; gray mud; May 15, 1908. One specimen.

Station 5411; between Cebu and Bohol; Lauis Point Light bearing N. 35° E., 4.7 miles distant (lat. 10°10′30″ N., long. 123°51′15″ E.); 265 meters; bottom temperature 12.89° C.; green mud; March 23, 1909. Two specimens.

Station 5412; between Cebu and Bohol; Lauis Point Light bearing N. 21° E., 5.5 miles distant (lat. 10°09′15″ N., long. 123°52′00″ E.); 296 meters; bottom temperature 12.67° C.; green mud; March 23, 1909. Two specimens.

Station 5415; between Cebu and Bohol; Lauis Point Light bearing N. 24° W., 7.3 miles distant (lat. 10°07′50″ N., long. 123°57′00″ E.); 161 meters; bottom temperature 16.89° C.; fine sand; March 24, 1909. Four specimens.

Station 5418; between Cebu and Bohol; Lauis Point Light bearing N. 16° E., 5.6 miles distant (lat. 10°08′50″ N., long. 123°52′30″ E.); 291 meters; bottom temperature 12.44° C.; gray mud and sand; March 25, 1909. Eight specimens.

Station 5420; between Cebu and Bohol; Cruz Point, Bohol, bearing S. 20° E., 6 miles distant (lat. 9°49′35″ N., long. 123°45′00″ E.); 232 meters; March 25, 1909. One specimen.

Station 5453; east coast of Luzon; Legaspi Light bearing S. 58° W., 4.5 miles distant (lat. 13°12′00″ N., long. 123°49′18″ E.); 267 meters; June 7, 1909. Four specimens.

Station 5501; in the vicinity of northern Mindanao; Macabalan Point Light, Mindanao, bearing S. 35° E., 8.2 miles distant (lat. 8°37′37″ N., long. 124°35′00″ E.); 391 meters; bottom temperature 12.39° C.; fine sand and gray mud; August 4, 1909. One specimen.

Station 5516; in the vicinity of northern Mindanao; Point Tagolo Light, Mindanao, bearing S. 80° W., 9.7 miles distant (lat. 8°46′00″ N., long. 123°32′30″ E.); 319 meters; bottom temperature 12.39° C.; globigerinae; August 9, 1909. Six specimens.

Station 5536; between Negros and Siquijor; Apo Island (C.) bearing S. 26° W., 11.8 miles distant (lat. 9°15′45″ N., long. 123°22′00″ E.); 510 meters; bottom temperature 11.95° C.; green mud; August 19, 1909. One young specimen.

Station 5537; between Negros and Siquijor; Apo Island (C.) bearing S. 46° W., 8.7 miles distant (lat. 9°11′00″ N., long. 123°23′00″ E.); 464 meters; bottom temperature 11.94° C.; green mud; August 19, 1909. One specimen.

Station 5565; between Jolo and Tawi Tawi; Dammi Island (N.) bearing S. 69° W., 6 miles distant (lat 5°51′42″ N., long. 120°30′30″ E.); 444 meters; bottom temperature 11.28° C.; sand and pteropod shells; September 21, 1909. Three specimens.

Station 5589; Sibuko Bay, Borneo; Mabul Island (NW.) bearing N. 3° W., 2.8 miles distant (lat. 4°12′10″ N., long. 118°38′08″ E.); 475 meters; bottom temperature 7.61° C.; fine gray sand and gray mud; September 29, 1909. Three specimens.

Station 5622; between Gillolo and Makyan Islands; Makyan Island (NE.) bearing N. 66° W., 4.1 miles distant (lat. 0°19′20″ N., long. 127°28′30″ E.); 503 meters; gray mud; November 29, 1909. Four specimens.

Station 5625; between Gillolo and Kayoa Islands; Kayoa Island (SE.) bearing S. 3° W., 6 miles distant (lat. 0°07′00″ N., long. 127°28′00″ E.); 420 meters; gray mud and fine sand; November 29, 1909. Two specimens.

Station 5645; in Buton Strait; North Island (NE.) bearing S. 10° W., 1.6 miles distant (lat. 5°29′06″ S., long. 122°36′06″ E.); 377 meters; December 16, 1909. One specimen.

Remarks.—None of these specimens exceed a size of 140 mm. in diameter. This is also the case with the several specimens that I have myself collected in the Philippine Sea and at the Kei Islands.

In Dr. H. L. Clark's Catalogue of the Recent Sea-Urchins in the British Museum the *Challenger* specimens are stated to range from 26 to 120 mm. in diameter. Döderlein's and de Meijere's largest specimens were, respectively, 115 and 130 mm. in diameter. It may then rather safely be said that Agassiz's statement that this species reaches a size of 200 mm. in diameter must be a mistake—probably a misprint for 120 mm.

The specimens at hand, some of which are in good and others in poor condition, are in general quite typical examples of this species, although in the specimens from stations 5241, 5242, 5243, and 5245 the spines of the aboral side are more slender and the tubercles correspondingly smaller, which makes them look somewhat different from the typical coarse-spined form. I do not, however, find any other characters distinguishing these specimens from the typical form, so that I must regard them as belonging to this same species, possibly representing a local race, though scarcely characteristic enough to be distinguished as a separate variety.

The specimens from station 5415 are red-brown, the others more dark purple, or nearly black—if not faded, as is the case with the specimens from station 5625. As they do not differ in any other way from the darker specimens, they must likewise be regarded as true *M. tuberculata.*

One of the specimens from station 5415 and some of those from station 5516 are interesting in carrying on their oral side examples of the epizoic ophiuran *Ophiosphaera*, all of them with the oral side turned away from the sea-urchin. Evidently this is a new species, but like *O. insignis* it carries the male on the oral side, covering the mouth of the female specimen and the arms of the female alternating with those of the male.

As was found to be the case with several species among the echinothurids, *Micropyga tuberculata* feeds largely on plant remains, from both phanerogams and algae, that have sunk to the bottom of the sea. But other bottom material also may form part of its diet.

MICROPYGA VIOLACEA de Meijere

Micropyga violacea DE MEIJERE, *Siboga* Echinoidea, p. 63, pl. 4, figs. 29, 30; pl. 15, figs. 232–234, 1904.

Localities.—Station 5114; Verde Island passage; Sombrero Island bearing N. 36° E., 7.2 miles distant (lat. 13°36′11″ N., long.

120°45′26″ E.); 622 meters; fine sand; January 20, 1908. One specimen.

Station 5115; Verde Island passage; Sombrero Island bearing N. 49° E., 7.3 miles distant (lat. 13°37′11″ N., long. 120°43′40″ E.); 622 meters; January 20, 1908. Two specimens.

Station 5284; China Sea, in the vicinity of southern Luzon; Malavatuan Island (S.) bearing N. 46° W., 14.25 miles distant (lat. 13°42′05″ N., long. 120°30′45″ E.); 771 meters; bottom temperature 5.72° C.; gray mud and globigerinae; July 20, 1908. Three specimens.

Station 5467; off the east coast of Luzon; Atulayan Island (S.) bearing S. 79° W., 2.5 miles distant (lat. 13°35′27″ N., long. 123°37′18″ E.); 877 meters; gray mud; June 18, 1909. Six specimens.

Station 5586; Sibuko Bay, Borneo; Sipadan Island (M.) bearing W., 9.4 miles distant (lat. 4°06′50″ N., long. 118°47′20″ E.); 634 meters; bottom temperature 6.67° C.; gray mud; September 28, 1909. One young specimen.

Station 5656; Gulf of Boni, Celebes; Olang Point bearing N. 67° W., 14.5 miles distant (lat. 3°17′40″ S., long. 120°36′45″ E.); 871 meters; gray mud; December 19, 1909. Three specimens.

Remarks.—All these specimens are in rather poor condition, more or less broken, this species being very delicate and fragile, much more so than the other species, *M. tuberculata.* Only a very few of the club-shaped oral primary spines, or of the umbrella-shaped tube-feet, are preserved, though enough to show that they are found in this species exactly as in *M. tuberculata*, which de Meijere could not determine in his single specimen.

Recently this species has been taken by the John Murray Expedition off the east African coast, which shows that the species is not confined to the Malay region, but must be distributed also all over the tropical part of the Indian Ocean.

Family DIADEMATIDAE

Genus ASTROPYGA Gray

ASTROPYGA RADIATA (Leske)

Astropyga radiata A. Agassiz, Revision of the Echini, pt. 1 [Mem. Mus. Comp. Zool., vol. 3], p. 94, 1872; pt. 3, p. 420, 1873.—Döderlein, Jenaische Denkschr., vol. 8, p. 699, pl. 59, figs. 6, 7, 1902.—Mortensen, The Danish Expedition to Siam 1899–1900, II. Echinoidea [Danske Selsk. Skr., ser. 7, vol. 1, No. 1], p. 18, pl. 3, figs. 15, 19; pl. 4, figs. 9, 17; pl. 5, fig. 27, 1904.

Locality.—Sirinao Island (SW.), Nakoda Bay, Palawan; December 30, 1908. Three large specimens.

Genus EREMOPYGA A. Agassiz and H. L. Clark

EREMOPYGA DENUDATA (de Meijere)

Astropyga denudata DE MEIJERE, *Siboga* Echinoidea, p. 57, pl. 4, figs. 31, 32; pl. 14, figs. 209–214, 1904.

Eremopyga denudata A. AGASSIZ and H. L. CLARK, Hawaiian and other Pacific Echini, Salenidae, etc., p. 122, 1908.

Localities.—Station 5140; in the vicinity of Jolo (Sulu); Jolo Light bearing S. 33° W., 6.1 miles distant (lat. 6°08′45″ N., long. 121°03′00″ E.), 139 meters; fine coral sand; February 14, 1908. One specimen.

Station 5448; east coast of Luzon; San Miguel Point bearing N. 23° E., 1.5 miles distant (lat. 13°23′10″ N., long 123°45′19″ E.); 86 meters; June 4, 1909. Two specimens.

Remarks.—Apart from some breakage of the test in the specimen from off Jolo these specimens are well preserved. The two from station 5448 are only half grown, about 45 mm. in horizontal diameter, but the genital pores are fully developed.

The label of the specimen from station 5140 states: "General color dark claret, lines of brilliant purple on ambulacral [should be interambulacral] area, 5 spots of same around periproct."

EREMOPYGA DEBILIS, new species

Characters.—This new species differs very conspicuously from the only other species of the genus *Eremopyga* known till now, *E. denudata*, in the tubercles being very suddenly reduced in the proximal half of the oral side so as to produce an appearance much like that of *Chaetodiadema.* That the species does not, however, belong to *Chaetodiadema* appears very clearly from the character of the ambulacra, the tubefeet being well developed and the pores arranged in the usual arcs of three up to the edge of the peristome. Also the structure of the spines is as in *E. denudata.*

The primary interambulacral tubercles are almost confined to the ambitus, there being only 5–7 tubercles in the outer adradial series. In the median area four series of large tubercles occur in the largest specimens, the two median series placed close together along the midline of the area.

The whole aboral side is very naked. The blue spots in the naked bifurcating interambulacral area are small, isolated spots, or are united into a vertical line. The apical system has oculars II and III, sometimes also ocular IV, exsert.

The test appears to be of a much more delicate structure than that of *E. denudata*, and all the specimens are more or less crushed. But it is clear that the normal shape is in the main like that of *E. denudata*, only it is not sunken at the peristomial edge or apically, and the ambulacra are not raised on the aboral side.

The color of the preserved specimens is a uniform dirty-gray mud-color, but it seems evident that this is due to the poor preservation.

Localities.—Station 5241; in the vicinity of Pujada Bay; Uanivan Island (N.) bearing S. 68° E., 3 miles distant (lat. 6°50′45″ N., long. 126°14′38″ E.); 393 meters; soft gray mud; May 14, 1908. Two young specimens.

Station 5242; in the vicinity of Pujada Bay; Uanivan Island (N.) bearing S. 56° E., 4 miles distant (lat. 6°51′53″ N., long. 126°14′10″ E.); 349 meters; bottom temperature 17.83° C.; soft gray mud; May 14, 1908. Five specimens.

Station 5243; in the vicinity of Pujada Bay; Uanivan Island (N.) bearing S. 66° E., 3.1 miles distant (lat. 6°50′55″ N., long. 126°14′35″ E.); 398 meters; bottom temperature 17.56° C.; gray mud; May 15, 1908. Four specimens.

Station 5244; in the vicinity of Pujada Bay; Uanivan Island (N.) bearing S. 52°30′ E., 4 miles distant (lat. 6°52′05″ N., long. 126°14′15″ E.); 313 meters; gray mud; May 15, 1908. Four specimens.

Remarks.—All these specimens are in a rather poor state of preservation; the two young specimens from station 5241 are in very poor condition.

A more detailed description, accompanied by the necessary illustrations, will be given in the Monograph of the Echinoidea, vol. 3, pt. 1.

It is interesting to find this new species at the same localities, off Uanivan Island, where also the above mentioned peculiar form of *Micropyga tuberculata* was found. But whereas the latter was scarcely sufficiently characterized for being regarded as more than a local race, the *Eremopyga* specimens are so well characterized that they must decidedly rank as a distinct species.

Genus CHAETODIADEMA Mortensen

CHAETODIADEMA GRANULATUM Mortensen

Chaetodiadema granulatum Mortensen, The Danish Expedition to Siam 1899–1900, II. Echinoidea [Danske Selsk. Skr., ser. 7, vol. 1, No. 1], p. 22, pl. 1, figs. 1, 3, 21, 22; pl. 3, fig. 11; pl. 4, figs. 1, 4, 13–15, 24, 32; pl. 5, figs. 10, 18, 19, 22, 35, 1904.—de Meijere, *Siboga* Echinoidea, p. 54, pl. 3, fig. 28; pl. 11, fig. 101; pl. 14, figs. 205–208, 1904.—H. L. Clark, Catalogue of the recent sea-urchins in the British Museum, p. 50, 1925.

Localities.—Station 5103; China Sea, off southern Luzon; Calaclan Point bearing S. 86° E., 2.5 miles distant (lat. 14°49′30″ N., long. 120°13′30″ E.); 37 meters; gray mud; January 7, 1908. Six specimens.

Station 5182; off eastern Panay; Antonia Island (S.) bearing N. 43° W., 3.7 miles distant (lat. 11°30′40″ N., long. 123°23′20″ E.); 44 meters; mud and fine sand; March 27, 1908. One large specimen.

Station 5220; between Marinduque and Luzon; San Andreas Island (W.) bearing S. 57° W., 8.5 miles distant (lat. 13°38′00″ N., long. 121°58′00″ E.); 91 meters; soft green mud; April 24, 1908. One specimen.

Station 5342; Halampaya Sound, Palawan; Endeavor Point (S.) bearing S. 58° E., 0.5 miles distant (lat. 10°56′55″ N., long. 119°17′24″ E.); 26–46 meters; gray mud; December 23, 1908. One young specimen.

Station 5358; Jolo (Sulu) Sea; Sandakan Light bearing S. 34° W., 19.7 miles distant (lat. 6°06′40″ N., long. 118°18′15″ E.); 71 meters; mud; January 7, 1909. Seven specimens.

Station 5360; in Iloilo Strait; Corregidor Light bearing N. 74° W., 6.9 miles distant (lat. 14°21′ N., long. 120°41′00″ E.); 22 meters; hard bottom; February 7, 1909. Eleven young specimens.

Station 5442; west coast of Luzon; San Fernando Point Light bearing N. 39° E., 8.4 miles distant (lat. 16°30′36″ N., long. 120°11′06″ E.); 82 meters, coral sand; May 10, 1909. Six young specimens.

Station 5477; between Samar and Leyte, in the vicinity of Surigao Strait; Tacbuc Point, Leyte, bearing S. 87° W., 11 miles distant (lat. 10°44′45″ N., long. 125°12′30″ E.); 88 meters; gray mud; July 29, 1909. One young specimen.

Remarks.—The specimen from station 5182 is no less than 120 mm. in horizontal diameter and is the largest specimen known of this species. The "bearded" part of the oral side is very large, the primary tubercles being confined to a narrow zone distally.

The specimens from station 5103 are somewhat darker than usual, perhaps colored by comatulids; in life the color evidently was the usual, the label stating "ten lines of sapphire spots in interambulacral areas, on brown dorsal surface, below white."

Parasite.—Two of the small specimens from stations 5358 and 5360 carry a small parasitic gastropod (*?Mucronalia*).

Genus DIADEMA Gray

DIADEMA SETOSUM (Leske)

Diadema saxatile Mortensen, The Danish Expedition to Siam 1899–1900, II. Echinoidea [Danske Selsk. Skr., ser. 7, vol. 1, No. 1], p. 9, pl. 3, figs. 22, 23, 29; pl. 4, figs. 26, 31, 34; pl. 5, figs. 2, 5, 8, 12, 14, 15, 1904.

Diadema setosum A. Agassiz and H. L. Clark, Hawaiian and other Pacific Echini, Salenidae, etc., p. 113, 1908.—H. L. Clark, Catalogue of the recent sea-urchins in the British Museum, p. 43, 1925.

Localities.—Tataan, Simulac Island; marginal coral reef; February 19, 1908. One young specimen.

San Pascual, Burrios Island; tide pool; March 8, 1909. One young specimen.

Jolo (Sulu); shore; June 3, 1908. One fine young specimen.

Station 5159; Tawi Tawi group, Jolo Archipelago; Tinakta Island (N.) bearing N. 82° W., 1.4 miles distant (lat. 5°11′50″ N., long. 119°54′00″ E.); 18 meters; coral sand; February 21, 1908. One young specimen, not with certainty identifiable as to the species.

Station 5108; China Sea, off southern Luzon; Corregidor Light bearing N. 39° E., 22.5 miles distant (lat. 14°05′05″ N., long. 120°19′45″ E.); 23 meters; coral bottom; January 15, 1908. Two specimens.

DIADEMA SAVIGNYI Michelin

Diadema savignyi Mortensen, The Danish Expedition to Siam 1899–1900, II. Echinoidea [Danske Selsk. Skr., ser. 7, vol. 1, No. 1], p. 16, pl. 3, figs. 6, 8; pl. 4, fig. 37; pl. 5, figs. 7, 9, 24, 1904.—A. Agassiz and H. L. Clark, Hawaiian and other Pacific Echini, Salenidae, etc., p. 114, 1908.—H. L. Clark, Catalogue of the recent sea-urchins in the British Museum, p. 43, 1925.

Localities.—Station 5149; in the vicinity of Siasi; Sirun Island (W.) bearing N. 39° E., 2.4 miles distant (lat. 5°33′00″ N., long. 120°42′10″ E.); 18 meters; coral and shells; February 18, 1908. One young specimen in poor condition.

No label. Two specimens.

Genus ECHINOTHRIX Peters

ECHINOTHRIX CALAMARIS (Pallas)

Echinothrix calamaris A. Agassiz, Revision of the Echini, pt. 3 [Mem. Mus. Comp. Zool., vol. 3], p. 413, pl. 3a, figs. 1, 2, 1873.—H. L. Clark, Catalogue of the recent sea-urchins in the British Museum, p. 44, 1925.

Localities.—Station 5138; in the vicinity of Jolo (Sulu); Jolo Light bearing S. 19° E., 2.5 miles distant (lat. 6°06′00″ N., long. 120°58′50″ E.); 37 meters; sand, shells, and coral; February 14, 1908. One small specimen.

Station 5142; in the vicinity of Jolo; Jolo Light bearing S. 50° W., 3.9 miles distant (lat. 6°06′10″ N., long 121°02′40″ E.); 38 meters; coral sand and shells; February 15, 1908. One specimen.

Station 5148; Jolo Archipelago, in the vicinity of Siasi; Sirun Island (N.) bearing S. 80° W., 3.8 miles distant (lat. 5°35′40″ N., long 120°47′30″ E.); 31 meters; coral sand; February 16, 1908. One large specimen.

Station 5149; in the vicinity of Siasi; Sirun Island (W.) bearing N. 39° E., 2.4 miles distant (lat. 5°33′00″ N., long. 120°42′10″ E.); 18 meters; coral and shells; February 18, 1908. Three specimens, one of them large.

Station 5159; Tawi Tawi group, Jolo Archipelago; Tinakta Island (N.) bearing N. 82° W., 1.4 miles distant (lat. 5°11′50″ N., long. 119°54′00″ E.); 18 meters; coral sand; February 21, 1908. One small specimen.

Bubuan Island, near Jolo; coral masses; February 14, 1908. One specimen.

Remarks.—With the exception of the one from station 5142, and that from Bubuan Island, these specimens are all poorly preserved. They call for no descriptive remarks. The specimen from station 5148 is a very large one, 114 mm. in diameter, and as denuded makes a splendid specimen, of perfectly typical shape and structure.

Family PEDINIDAE

Genus CAENOPEDINA A. Agassiz

CAENOPEDINA ANNULATA, new species

Characters.—This new species bears a considerable general resemblance to the Japanese species *C. mirabilis* (Döderlein), but its primary spines are much more banded than in the latter—12 to 14 narrow, well-delimited reddish-brown bands on a greenish-white ground color. The characters of the test are as in *C. mirabilis*, but the genital plates offer a conspicuous character in the rather numerous tubercles (spines) being arranged in an inner and an outer band, separated by a broad, naked belt. The ophicephalous pedicellariae of the test are unique among the species of *Caenopedina* in having a very short broad blade, without any stalklike constriction at the base. The small tridentate pedicellariae have a characteristic widening of the edge in the basal part of the blade. The large form of tridentate pedicellariae was not found in the specimens at hand. The other pedicellariae are of the form usual in *Caenopedina.*

A full description and figures will be published in vol. 3, pt. 1, of my Monograph of the Echinoidea.

Localities.—Station 5617; Dodinga Bay, Gillolo; Ternate Island (SE.) bearing S. 45° W., 7 miles distant (lat. 0°49′30″ N., long. 127°25′30″ E.); 239 meters; coral; November 27, 1909. One fine specimen 31 mm. in horizontal diameter—the holotype.

Station 5168; Tawi Tawi group, Jolo (Sulu) Archipelago; Observation Island bearing N. 17° W., 4.2 miles distant (lat. 4°56′30″ N., long. 119°45′40″ E.); 146 meters; coral sand; February 25, 1908. One specimen 22 mm. in diameter.

CAENOPEDINA INDICA (de Meijere)

Hemipedina indica DE MEIJERE, *Siboga* Echinoidea, p. 65, pl. 3, fig. 27; pl. 15, fig. 235; pl. 16, figs. 236–242, 1904.

Caenopedina indica H. L. CLARK, Hawaiian and other Pacific Echini, Pedinidae, etc., p. 217, 1912.

Localities.—Station 5259; off northwestern Panay; Caluya Island (S.) bearing S. 73° W., 12 miles distant (lat. 11°57′30″ N., long.

121°42′15″ E.); 570 meters; bottom temperature 9.61° C.; gray mud and globigerinae; June 3, 1908. One specimen.

Station 5282; China Sea, in the vicinity of southern Luzon; Malavatuan Island (N.) bearing S. 84° W., 6.2 miles distant (lat. 13°53′00″ N., long. 120°26′45″ E.); 453 meters; bottom temperature 8.56° C.; dark gray sand; July 18, 1908. One specimen.

Station 5325; off northern Luzon; Hermanos Island (N.) bearing N. 86° E., 16.75 miles distant (lat. 18°34′15″ N., long. 121°51′15″ E.); 409 meters; bottom temperature 11.78° C.; green mud; November 12, 1908. Two specimens.

Station 5430; in the vicinity of eastern Palawan; Fondeado Islands (W.) bearing N. 57° W., 10.5 miles distant (lat. 9°49′40″ N., long. 119°03′20″ E.); 848 meters; bottom temperature 10.00° C.; globigerina ooze; April 6, 1909. One specimen.

Remarks.—The specimen from station 5430 is a large and splendid example, 30 mm. in horizontal diameter and, together with the type specimen of *C. annulata*, among the finest specimens of *Caenopedina* known up to the present. The other specimens range from 23 to 26 mm. in horizontal diameter but are not so finely preserved.

Order CAMARODONTA

Family TEMNOPLEURIDAE

Genus PRIONECHINUS A. Agassiz

PRIONECHINUS FORBESIANUS (A. Agassiz)

Cottaldia forbesiana A. Agassiz, *Challenger* Reports, Zoology, vol. 3, pt. 9, p. 112, pl. 6a, figs. 15–17, 1881.

Arbacina forbesiana Mortensen, *Ingolf* Echinoidea, pt. 1, p. 83, pl. 7, figs. 22, 26, 32; pl. 8, fig. 33, 1903.

Prionechinus forbesianus de Meijere, *Siboga* Echinoidea, p. 71, pl. 4, figs. 33, 34; pl. 16, figs. 250–255, 1904.—H. L. Clark, Hawaiian and other Pacific Echini, Pedinidae, etc., p. 304, 1912; Catalogue of the recent sea-urchins in the British Museum, p. 79, 1925.

Localities.—Station 5112; China Sea, off southern Luzon; Sombrero Island bearing S. 18° E., 6.75 miles distant (lat. 13°48′22″ N., long. 120°47′25″ E.); 324 meters; bottom temperature 11.33° C.; dark green mud; January 17, 1908. One very young specimen—identification uncertain.

Station 5123; east coast of Mindoro; Malabrigo Light bearing N. 44° W., 32.5 miles distant (lat. 13°12′45″ N., long. 121°38′45″ E.); 517 meters; green mud; February 2, 1908. One fine adult specimen.

Station 5411; between Cebu and Bohol; Lauis Point Light bearing N. 35° E., 4.7 miles distant (lat. 10°10′30″ N., long. 123°51′15″ E.); 265 meters; bottom temperature 12.89° C.; green mud; March 23, 1909. One young specimen.

Station 5607; Gulf of Tomini, Celebes; Binang Unang Island (E.) bearing S. 36° E., 5 miles distant (lat. 0°04′00″ S., long. 121°36′00″ E.); 1,391 meters; fine sand; November 18, 1909. Two adult specimens, one of them abnormal.

Station 5619; Molucca passage; Mareh Island (S.) bearing S. 78° E., 7 miles distant (lat. 0°35′00″ N., long. 127°14′40″ E.); 795 meters; fine gray sand and mud; November 27, 1909. One fine adult and one young specimen.

Station 5664; Macassar Strait; Kapoposang Light bearing N. 66° E., 3.8 miles distant (lat. 4°43′22″ S., long. 118°53′18″ E.); 731 meters; bottom temperature 6.28° C.; hard bottom; December 28, 1909. Twelve young specimens.

Remarks.—One of the specimens from station 5607 was remarkable in having the genital pores, situated in the middle of the genital plates, very small. On opening it, I found no traces of the genital organs, which ordinarily are quite easy to find, even in much smaller specimens. There can be no doubt that this specimen is abnormal—castrated for some reason. No parasites were found on or within it.

There is a pronounced sexual difference, the genital pores of the female being situated in the middle, or nearer the inner edge, the very small pores of the male at the very tip of the genital plates. Such sexual difference is found also in the other species of *Prionechinus* and must be regarded as an important character of the genus *Prionechinus*.

PRIONECHINUS SAGITTIGER A. Agassiz

Prionechinus sagittiger A. Agassiz, *Challenger* Reports, Zoology, vol. 3, pt. 9, p. 109, pl. 6a, figs. 11–14, 1881.—Mortensen, *Ingolf* Echinoidea, pt. 1, p. 82, pl. 7, figs. 21, 25, 29, 1903.—de Meijere, *Siboga* Echinoidea, p. 70, pl. 16, figs. 245–249, 1904.—Döderlein, Wiss. Ergebn. Tiefsee-Exped., vol. 5, Lief. 2, p. 196, pl. 25, fig. 1; pl. 35, fig. 6; pl. 46, fig. 5, 1906.—H. L. Clark, Hawaiian and other Pacific Echini, Pedinidae, etc., p. 304, 1912; Catalogue of the recent sea-urchins in the British Museum, 1925, p. 79.

Locality.—Station 5661; Flores Sea; Cape Lassa bearing N. 21° E., 12.5 miles distant (lat. 5°49′40″ S., long. 120°24′30″ E.); 329 meters; hard bottom; December 20, 1909. One young specimen.

Genus ORECHINUS Döderlein

ORECHINUS MONOLINI (A. Agassiz)

Trigonocidaris monolini A. Agassiz, *Challenger* Reports, Zoology, vol. 3, pt. 9, Echinoidea, p. 111, pl. 6a, figs. 8–10, 1881.

Genocidaris monolini de Meijere, *Siboga* Echinoidea, p. 74, pl. 4, figs. 35–37; pl. 16, figs. 356–263, 1904.

Orechinus monolini Döderlein, Wiss. Ergebn. Tiefsee-Exped., vol. 5, Lief. 2, p. 196, pl. 25, fig. 1; pl. 35, fig. 6; pl. 46, fig. 5, 1906.—H. L. Clark, Hawaiian and other Pacific Echini, Pedinidae, etc., p. 300, pl. 93, figs. 27–31, 1912.

Localities.—Station 5601; Gulf of Tomini, Celebes; Limbe Island (NE.) bearing N., 20.7 miles distant (lat. 1°13′10″ N., long. 125°17′05″ E.); 1,398 meters; sand, globigerinae, and pteropods; November 13, 1909. Two specimens.

Station 5614; Molucca passage; Tifori Island (C.) bearing N. 19° E., 30.5 miles distant (lat. 0°31′00″ N., long. 125°58′45″ E.); 2,010 meters; gray mud, sand, and globigerinae; November 22, 1909. One young specimen.

Station 5637; near Bouro Island; Amblau Island (N.) bearing N. 80° E., 21 miles distant (lat. 3°53′20″ S., long. 126°48′00″ E.); 1,280 meters; gray mud; December 10, 1909. One specimen.

Remarks.—These are quite typical specimens, though varying to some degree in regard to the sculpture of the test and apical system.

Genus TEMNOPLEURUS A. Agassiz

TEMNOPLEURUS REEVESII (Gray)

Temnopleurus reevesii Mortensen, The Danish Expedition to Siam 1899–1900, II. Echinoidea [Danske Selsk. Skr., ser. 7, vol. 1, No. 1], p. 62, pl. 6, figs. 3, 10, 12; pl. 7, fig. 37, 1904.—H. L. Clark, Hawaiian and other Pacific Echini, Pedinidae, etc., p. 313, 1912.—H. L. Clark, Catalogue of the recent sea-urchins in the British Museum, p. 81, 1925.

Localities.—Station 5381; Ragay Gulf, Luzon; Arena Point, Luzon, bearing S. 68° W., 2.8 miles distant (lat. 13°14′15″ N., long. 122°44′45″ E.); 161 meters; coral sand; March 6, 1909. Four fine specimens.

Station 5382; Ragay Gulf, Luzon; Arena Point, Luzon, bearing S. 55° W., 3.8 miles distant (lat. 13°15′20″ N., long. 122° 45′30″ E.); 234 meters; mud; March 6, 1909. One young specimen.

Station 5475; east coast of Luzon; San Bernardino Light bearing S. 27° W., 11 miles distant (lat. 12° 55′25″ N., long. 124° 22′12″ E.); 356 meters; bottom temperature 15.17° C.; shells; June 24, 1909. Four specimens.

Station 5476; east coast of Luzon; San Bernardino Light bearing S. 37° W., 13.5 miles distant (lat. 12°56′24″ N., long. 124°25′24″ E.); 493 meters; bottom temperature 9.06° C.; fine sand; June 24, 1909. Three specimens.

Station 5547; near Jolo (Sulu); Noble Point, Tulayan Island (E.) bearing S. 38° E., 9.5 miles distant (lat. 6°09′20″ N., long. 121°13′40″ E.); 283 meters; bottom temperature 13.50° C.; fine sand; September 15, 1909. Two specimens.

TEMNOPLEURUS DECIPIENS (de Meijere)

Genocidaris decipiens de Meijere, *Siboga* Echinoidea, p. 76, pl. 16, figs. 264–266, 1904.

Localities.—Station 5159; Tawi Tawi group, Jolo (Sulu) Archipelago; Tinakta Island (N.) bearing N. 82° W., 1.4 miles distant (lat. 5°11′50″ N., long. 119°54′00″ E.); 18 meters; coral sand; February 21, 1908. One specimen.

Station 5164; Tawi Tawi group, Jolo Archipelago; Observation Island bearing S. 82° W., 8 miles distant (lat. 5°01′40″ N., long. 119°52′20″ E.); 33 meters; green mud; February 24, 1908. Four specimens.

Remarks.—Although these specimens are only dead tests, without the apical systems, the identification as *T. decipiens* is beyond doubt, the very characteristic sculpture of the test being quite sufficient for the certain recognition of this species.

That this species has nothing to do with *Genocidaris*, but is a near relation of *Temnopleurus reevesii* (Gray), will be set forth in vol. 3, pt. 2, of my Monograph of the Echinoidea.

Genus DESMECHINUS H. L. Clark

DESMECHINUS VERSICOLOR (Mortensen)

Gymnechinus versicolor Mortensen, The Danish Expedition to Siam 1899–1900, II. Echinoidea [Danske Selsk. Skr., ser. 7, vol. 1, No. 1], p. 116, pl. 7, figs. 24, 26, 30, 1904.—H. L. Clark, Catalogue of the recent sea-urchins in the British Museum, p. 129, 1925.

Locality.—Station 5355; North Balabac Strait; Balabac Light bearing S. 61° W., 16.6 miles distant (lat. 8°08′10″ N., long. 117°19′15″ E.); 80 meters; coral and sand; January 5, 1909. One specimen.

Remarks.—This specimen, of 20 mm. horizontal diameter and thus evidently adult, is rather unusually dark, being olive along the median spaces of both ambulacra and interambulacra on the aboral side. The spines are greenish but with the usual red bands.

This species is no *Gymnechinus*, but a temnopleurid of the genus *Desmechinus*, as will be explained in vol. 3, pt. 2, of my Monograph of the Echinoidea.

DESMECHINUS RUFUS (Bell)

Salmacis rufa Bell, Proc. Zool. Soc. London, 1894, 411, pl. 26, figs. 2, 3.

Psammechinus rufus Mortensen, The Danish Expedition to Siam 1899–1900, II. Echinoidea [Danske Selsk. Skr., ser. 7, vol. 1, No. 1], p. 122, pl. 5, fig. 16; pl. 7, figs. 34, 43, 1904.

Lytechinus rufus H. L. Clark, Hawaiian and other Pacific Echini, Pedinidae, etc., p. 246, 1912.

Locality.—Station 5179; in the vicinity of Romblon; Romblon Light bearing S. 56° E., 4.5 miles distant (lat. 12°38′15″ N., long. 122°12′30″ E.); 68 meters; bottom temperature 24.28° C.; hard sand; March 25, 1908. One old broken test.

Remarks.—In spite of being in poor condition, with the apical system lost, this test proves itself, by its characteristic red mottled color as well as by its test structure, definitely to belong to the present species, which, like the species *versicolor*, belongs to the genus *Desmechinus*, as will be set forth in vol. 3, pt. 2, of my Monograph of the Echinoidea.

Genus SALMACIS L. Agassiz

SALMACIS BICOLOR L. Agassiz

Salmacis bicolor, var. *rarispina* MORTENSEN, The Danish Expedition to Siam 1899–1900, II. Echinoidea [Danske Selsk. Skr., ser. 7, vol. 1, No. 1], p. 65, pl. 6, figs. 2, 4, 23, 26, 39, 40; pl. 7, fig. 1, 1904.

Salmacis bicolor H. L. CLARK, Catalogue of the recent sea-urchins in the British Museum, p. 84, 1925.

Localities.—Station 5137; in the vicinity of Jolo (Sulu); Jolo Light bearing S. 61° E., 1.3 miles distant (lat. 6°04′25″ N., long. 120°58′30″ E.); 36 meters; sand and shells; February 14, 1908. One specimen.

Station 5174; in the vicinity of Jolo; Jolo Light bearing E. 2.6 miles distant (lat. 6°03′45″ N., long. 120°57′00″ E.); 36 meters; coarse sand; March 5, 1908. One specimen.

Station 5149; in the vicinity of Siasi; Sirun Island (W.) bearing N. 39° E., 2.4 miles distant (lat. 5°33′00″ N., long. 120°42′10″ E.); 18 meters; coral and shells; February 18, 1908. One large and one small specimen.

Station 5151; Tawi Tawi group, Jolo Archipelago; Sirun Island (C.) bearing N. 58° E., 19.3 miles distant (lat. 5°24′40″ N., long. 120°27′15″ E.); 44 meters; coral sand and shells; February 18, 1908. One large broken specimen.

Station 5442; west coast of Luzon; San Fernando Point Light bearing N. 39° E., 8.4 miles distant (lat. 16°30′36″ N., long. 120°11′06″ E.); 82 meters; coral sand; May 10, 1909. Three specimens, two large and one small.

Station 5482; in the vicinity of Surigao Strait; Cabugan Grande Island (N.) bearing N. 87° W., 4.5 miles distant (lat. 10°27′30″ N., long. 125°18′00″ E.); 122 meters; broken shells, sand, and green mud; July 30, 1909. Three specimens.

Station 5555; in the vicinity of Jolo; Cabalian Point, Jolo, bearing N. 50° W., 3.3 miles distant (lat. 5°51′15″ N., long 120°58′35″ E.); 62 meters; coarse sand; September 18, 1909. One small specimen.

Station 5557; in the vicinity of Jolo; Cabalian Point, Jolo, bearing N. 70° W., 5.2 miles distant (lat. 5°51′30″ N., long. 121°01′00″ E.); 24 meters; sand and coral; September 18, 1909. One small fine specimen.

Remarks.—The small specimens are interesting in showing, in the horizontal interambulacral sutures, a distinct depression on each side of the primary tubercle; also the dark color of the sutures makes them very conspicuous on the whitish ground color of the test. They produce a marked *Temnopleurus*-like aspect. It should be pointed out that I have found the above-mentioned depressions also in other young specimens of this species.

The specimen from station 5151 has the whole apical system deeply sunken, as if pressed in. It does not seem to be due to the effect of the presence of some parasitic organism.

Parasite.—A broken specimen of medium size from station 5482 is infested by three parasitic snails attached to the aboral side halfway to the apical system. They have produced the effect that the test has become abnormally constricted, the uppermost part forming like a top on the lower part. At the level of the parasites are found a number of small brownish bodies loosely attached to the test. They seem to be egg masses of the snails, but the preservation is not good enough for ascertaining definitely their nature. The brown color appears to be due to the alcohol having been colored by crinoids.

SALMACIS SPHAEROIDES (Linnaeus)

Salmacis sphaeroides MORTENSEN, The Danish Expedition to Siam 1899–1900, II. Echinoidea [Danske Selsk. Skr., ser 7, vol. 1, No. 1], p. 70, pl. 5, fig. 23; pl. 6, figs. 1, 11, 41, 1904.—H. L. CLARK, Catalogue of the recent sea-urchins in the British Museum, p. 87, 1925.

Localities.—Station 5165; Tawi Tawi group, Sulu (Jolo) Archipelago; Observation Island bearing N. 70° W., 6.4 miles distant (lat. 4°58′20″ N., long. 119°50′30″ E.); 16 meters; coral; February 24, 1909. One specimen.

Catbalogan, Sámar; littoral; April 15, 1908. One specimen.

Remarks.—The specimen from station 5165 is unusual in that the bases of most of the spines are not greenish, but reddish or purple, recalling *S. bicolor*, but in its other characters it is a typical *sphaeroides*, so there can be no doubt that it is really *sphaeroides*. The test is nearly white, with merely an indication of a dark band of isolated spots at the ambitus.

SALMACIS VIRGULATA L. Agassiz

Salmacis virgulata typica DÖDERLEIN, Jenaische Denkschr., vol. 8, p. 712, pl. 62, fig. 2. 1902.—MORTENSEN, the Danish Expedition to Siam 1899–1900, II. Echinoidea [Danske Selsk. Skr., ser. 7, vol. 1, No. 1], p. 68, pl. 6, figs. 7, 18, 46, 47; pl. 7, fig. 40. 1904.

Locality.—Station 5157; Tawi Tawi group, Jolo (Sulu) Archipelago; Tinakta Island (N.) bearing S. 80° W., 3.3 miles distant (lat. 5°12′30″ N., long. 119°55′50″ E.); 33 meters; fine sand and shells; February 21, 1908. One fine specimen of the form *typica*.

SALMACIS DUSSUMIERI L. Agassiz

Salmacis dussumieri Döderlein, Jenaische Denkschr., vol. 8, p. 715, pl. 63, figs. 5–5c, 1902.—Mortensen, The Danish Expedition to Siam 1899–1900, II. Echinoidea [Danske Selsk. Skr., ser. 7, vol. 1, No. 1], p. 72, pl. 7, fig. 15, 1904.

Localities.—Station 5433; in the vicinity of eastern Palawan; Corandagos Island (NW.) bearing N. 35° E., 6.5 miles distant (lat. 10° 37′30″ N., long. 120°11′05″ E.); 99 meters; green mud and coral sand; April 8, 1909. One young specimen.

Station 5181; off eastern Panay; Antonia Island (S.) bearing S. 63° W., 6.6 miles distant (lat. 11°36′40″ N., long 123°26′35″ E.); 47 meters; mud and fine sand; March 27, 1908. Two young specimens.

Genus TEMNOTREMA A. Agassiz

TEMNOTREMA SIAMENSE (Mortensen)

Pleurechinus siamensis Mortensen, The Danish Expedition to Siam 1899–1900, II. Echinoidea [Danske Selsk. Skr., ser. 7, vol. 1, No. 1], p. 79, pl. 1, figs. 2, 7, 11, 20; pl. 2, figs. 2, 9, 14, 15, 22, etc., 1904.

Temnotrema siamensis H. L. Clark, Hawaiian and other Pacific Echini, Pedinidae, etc., p. 318, 1912.

Temnotrema siamense H. L. Clark, Catalogue of the recent sea-urchins in the British Museum, p. 92, 1925.

Localities.—Station 5143; in the vicinity of Jolo (Sulu); Jolo Light bearing S. 50° W., 3.4 miles distant (lat. 6°05′50″ N., long. 121°02′15″ E.); 35 meters; coral sand; February 15, 1908. Two specimens.

Station 5159; Tawi Tawi group, Jolo Archipelago; Tinakta Island (N.) bearing N. 82° W., 1.4 miles distant (lat. 5°11′50″ N., long. 119°54′00″ E.); 18 meters; coral sand; February 21, 1908. Three specimens.

Remarks.—The two specimens from station 5143 and two of those from station 5159 are naked tests, without the apical system. The identification of these specimens is not fully certain. The third specimen, from station 5159, is a fairly well preserved adult 10 mm. in diameter. The color is a light brownish, mottled with greenish olive. The spines are very light greenish, with a narrow brownish band distally. The very few spines that are not broken have a slight terminal swelling. There can be no doubt that this specimen is a typical *T. siamense*.

TEMNOTREMA PULCHELLUM (Mortensen)

Pleurechinus siamensis, var. *pulchellus* Mortensen, The Danish Expedition to Siam 1899–1900, II. Echinoidea [Danske Selsk. Skr., ser. 7, vol. 1, No. 1], p. 82, 1904.

Locality.—Station 5218; between Burias and Luzon; Anima Sola Island (E.) bearing N. 10° W., 2 miles distant (lat. 13°11′15″ N., long. 123°02′45″ E.); 36 meters; coarse sand; April 22, 1908. One specimen.

Remarks.—As will be explained in my Monograph of the Echinoidea, vol. 3, pt. 2, this form is not related to *T. siamense*, but to *T. maculatum*, of which it may perhaps be only a color variety, like *T. pallescens* H. L. Clark. But in any case it is so characteristic in its uniform red or purplish color that it must be kept separate, be it as a distinct species, as I think preferable, or only as a variety of *T. maculatum*.

TEMNOTREMA RETICULATUM (Mortensen)

Pleurechinus reticulatus Mortensen, *in* de Meijere, *Siboga* Echinoidea, p. 202, 1904.

Locality.—Station 5400; north of Cebu; Tanguingui Island Light bearing N. 77° W., 22.5 miles distant (lat. 11°24′24″ N., long. 124°05′30″ E.); 46 meters; sand and shells; March 18, 1909. One specimen.

Remarks.—The specimen taken by the *Albatross* off Cebu is a well-preserved and perfectly typical specimen. In spite of its small size, 4.5 mm. in diameter, it is adult. The species apparently does not reach a larger size than about 5 mm. in diameter.

This species has never been properly described. In his *Siboga* Echinoidea de Meijere mentioned the species *Pleurechinus reticulatus*, characterized by its thorny spines and its large suranal plate, distinguished by me among the specimens he had identified as *Pleurechinus bothryoides*. He refers to the description that was to be given in my work on the Siam Echinoidea. In the meantime, however, I had come to the conclusion that the form I had distinguished as *Pleurechinus reticulatus* should rather be united with *P. scillae* (Mazzetti), and so I withdrew *reticulatus* as a synonym only of *P. scillae*. The study of the rich material of these forms that I collected in the Malay Archipelago in 1922 and 1929, and in the Gulf of Suez in 1936, has, however, convinced me that the form originally distinguished as *P. reticulatus* is so characteristic and constant that it must be regarded as a distinct species, the name of which is thus to be *Temnotrema reticulatum* (Mortensen). A full description of this species will be given in vol. 3, pt. 2, of my Monograph of the Echinoidea.

Genus MICROCYPHUS L. Agassiz and Desor

MICROCYPHUS EXCENTRICUS, new species

Characters.—The single specimen is a small one, 17 mm. in horizontal diameter and 11 mm. high. It is distinctly pentagonal, slightly sunken in the interambulacra. The naked areas in the ambulacra as well as in the interambulacra are broad and sharply delimited against the tuberculated part of the plates. The primary

ambulacral tubercles are distinct and form a regular series throughout. The interambulacral primary tubercles do not form distinct vertical series, and there are no horizontal series on any of the plates. The pore pairs are not arranged biserially or in distinct arcs of three. The apical system is seen to have been distinctly elongate. The peristome is large, 47 percent of the diameter of the test. The gill slits are small but fairly sharp. The color of the naked areas is reddish, a little darker along the sutures; a narrow dark line separates the naked areas sharply from the whitish tuberculated part of the plates.

Locality.—Pangasinan Island, near Jolo (Sulu); reef in the southern part; scattered coral; February 13, 1908. One naked test without apical system, probably found on the beach.

Remarks.—This species recalls to some degree a young *Coelopleurus*. It is very regrettable that only a single naked test of this species was found. The characters of the test alone, however, distinguish it markedly from all other known recent species of *Microcyphus*. On the other hand, it shows a considerable likeness to the fossil *Microcyphus javanus* Jeannet from the Miocene of Java, and it is very likely that it is the direct descendant of this fossil species. In this latter the apical system is not elongate as it is in the recent form, and if this be a constant character, which cannot be stated definitely from the single known specimen, this will mean that the recent form has undergone a remarkable specialization in this regard.

MICROCYPHUS species

Note.—The collection includes two naked worn tests lacking the apical system, without locality, of some species of *Microcyphus*. I do not think it possible to identify them with certainty as to species.

Genus MESPILIA L. Agassiz and Desor

MESPILIA GLOBULUS (Linnaeus)

Mespilia globulus A. Agassiz, Revision of the Echini, pt. 3 [Mem. Mus. Comp. Zool., vol. 3], p. 477, pl. 8a, figs. 13, 14, 1873.—Mortensen, The Danish Expedition to Siam 1899–1900, II. Echinoidea [Danske Selsk. Skr., ser. 7, vol. 1, No. 1], p. 96, pl. 7, figs. 16, 22, 33, 47, 1904.—H. L. Clark, Hawaiian and other Pacific Echini, Pedinidae, etc., p. 322, 1912; Catalogue of the recent sea-urchins in the British Museum, p. 93, 1925.

Localities.—Station 5159; Tawi Tawi group, Jolo (Sulu) Archipelago; Tinakta Island (N.) bearing N. 82° W., 1.4 miles distant (lat. 5°11′50″ N., long. 119°54′00″ E.); 18 meters; coral sand; February 21, 1908. Two specimens.

Cebu reef; April 4, 1908. One specimen.

Station 5557; in the vicinity of Jolo; Cabalian Point bearing N. 70° W., 5.2 miles distant (lat. 5°51′30″ N., long. 121°01′00″ E.); 24 meters; sand and coral; September 17, 1909. One specimen.

Family TOXOPNEUSTIDAE

Genus TOXOPNEUSTES L. Agassiz

TOXOPNEUSTES PILEOLUS (Lamarck)

Toxopneustes pileolus Mortensen, *Ingolf* Echinoidea, pt. 1, p. 111, pl. 21, figs. 13, 21, 41, 1903; The Danish Expedition to Siam 1899–1900, II. Echinoidea [Danske Selsk. Skr., ser. 7, vol. 1, No. 1], p. 120, 1904.—H. L. Clark, Catalogue of the recent sea-urchins in the British Museum, p. 123, 1925.

Localities.—Station 5138; in the vicinity of Jolo (Sulu); Jolo Light bearing S. 19° E., 2.5 miles distant (lat. 6°06′00″ N., long. 120°58′50″ E.); 35 meters; sand and coral; February 14, 1908. One specimen.

Station 5149; in the vicinity of Siasi; Sirun Island (W.) bearing N. 39° E., 2.4 miles distant (lat. 5°33′00″ N., long. 120°42′10″ E.); 18 meters; coral and shells; February 18, 1908. One broken specimen.

Station 5155; Tawi Tawi group, Jolo Archipelago; Bakun Point bearing N. 70° E., 1.7 miles distant (lat 5°13′40″ N., long. 119°57′20″ E.); 22 meters; coral sand; February 19, 1908. One young specimen.

Remarks.—The specimen from station 5138 is a large one, about 125 mm. in diameter, but badly broken. The spines of the aboral side are green, but those of the oral side are distinctly red at the base, as is typical of this species.

Genus TRIPNEUSTES L. Agassiz

TRIPNEUSTES GRATILLA (Linnaeus)

Tripneustes gratilla Lovén, Bihang Svenska Vet. Akad. Handl., vol. 13, pt. 4, No. 5, p. 77, 1887.—H. L. Clark, The echinoderm fauna of Torres Strait, p. 148, pl. 17, fig. 6, 1921; Catalogue of the recent sea-urchins in the British Museum, p. 124, 1925.

Localities.—Station 5165; Tawi Tawi group, Jolo (Sulu) Archipelago; Observation Island bearing N. 70° W., 6.4 miles distant (lat. 4°58′20″ N., long. 119°50′30″ E.); 17 meters; coral; February 24, 1909. Three specimens.

Station 5149; in the vicinity of Siasi; Sirun Island (W.) bearing N. 39° E., 2.4 miles distant (lat. 5°33′00″ N., long. 120°42′10″ E.); 18 meters; coral and shells; February 18, 1908. Two specimens, one large and one young.

Joló; shore; March 6, 1908. One specimen.

Romblon; shore; March 26, 1908. Three specimens.

Tilig Bay, southern Luzon; June 15, 1908. One specimen.

Varadero Bay, Mindoro; July 23, 1908. Two specimens.

Port Matalvi, Luzon; November 23, 1909. One specimen.

Pandanon Island; March 23, 1909. One specimen.

San Pascual, Burias Island; tide pool; March 8, 1909. One young specimen.

Atulayan Island; littoral; June 18, 1909. Ten specimens.

Tomahu Island; tide pool; December 12, 1909. One specimen.

Family ECHINOMETRIDAE

Genus PARASALENIA A. Agassiz

PARASALENIA GRATIOSA A. Agassiz

Parasalenia gratiosa A. Agassiz, Revision of the Echini, pt. 3 [Mem. Mus. Comp. Zool., vol. 3], p. 435, pl. 3d, figs. 1, 2; pl. 6, fig. 14, 1873.—Mortensen, The Danish Expedition to Siam 1899–1900, II. Echinoidea [Danske Selsk. Skr., ser. 7, vol. 1, No. 1], p. 121, pl. 5, fig. 36, 1904.—H. L. Clark, Hawaiian and other Pacific Echini, Pedinidae, etc., p. 369, 1912; Catalogue of the recent sea-urchins in the British Museum, p. 141, 1925.

Localities.—Station 5109; China Sea, off southern Luzon; Corregidor Light bearing N. 42° E., 25.8 miles distant (lat. 14°03′45″ N., long. 120°16′30″ E.); 18 meters; coral; January 15, 1908. One specimen.

Station 5159; Tawi Tawi group, Joló (Sulu) Archipelago; Tinakta Island (N.) bearing N. 82° W., 1.4 miles distant (lat. 5°11′50″ N., long. 119°54′00″ E.); 19 meters; coral sand; February 21, 1908. One specimen.

Apra Bay, Guam; November 19, 1907. Four specimens.

Tataan, Simulac Island; February 19, 1908. One specimen.

Remarks.—The specimen from station 5159, although an adult 24 mm. long, has the genital plates almost naked; only a small tubercle is found at the inner edge of genitals 2 and 3. Also in the largest specimen from Guam, 17 mm. long, the genital plates are entirely naked. Accordingly the presence or absence of tubercles on the genital plates gives no reliable distinction between *P. gratiosa* and *P. pöhlii*, as H. L. Clark thinks, using this character in his key to the species of *Parasalenia*.

Parasite.—On the specimen from station 5159 was found a specimen of the interesting epizoic ophiuran *Ophiosphaera*, carrying, as usual, the pygmy male individual across its mouth. As usual, the female had its back toward the test of the sea-urchin.[7]

PARASALENIA PÖHLII Pfeffer

Parasalenia pöhlii H. L. Clark, Hawaiian and other Pacific Echini, Pedinidae, etc., p. 369, pl. 95, figs. 1–5, 1912.

Parasalenia poehli H. L. Clark, Catalogue of the recent sea-urchins in the British Museum, p. 142, 1925.

[7] Cf. Mortensen, Vid. Medd. Dansk Naturh. Foren., vol. 93, p. 183, 1933.

Locality.—Station 5109; China Sea, off southern Luzon; Corregidor Light bearing N. 42° E., 25.8 miles distant (lat. 14°03′45″ N., long 120°16′30″ E.); 18 meters; coral; January 15, 1908. One young specimen.

Genus SELENECHINUS de Meijere

SELENECHINUS ARMATUS de Meijere

Selenechinus armatus DE MEIJERE, *Siboga* Echinoidea, p. 99, pl. 5, figs. 38, 39; pl. 17, figs. 291–299, 1904.

No locality.—Two specimens.

Remarks.—The collection contains two specimens, the larger of them 100 mm. in diameter, agreeing completely with the description and figures given by de Meijere. Unfortunately they are without any label, which is the more regrettable since the type and only specimen hitherto recorded likewise had no label, so that de Meijere could state only that most probably it came from the Jolo Sea. This may very probably be the case also with the *Albatross* specimens, but there is no certainty, and likewise the depth at which it was taken remains unknown.

Genus ECHINOSTREPHUS A. Agassiz

ECHINOSTREPHUS FORMOSUS, new species

Characters.—The test is very low, only 5 mm. in height, with a horizontal diameter of 13 mm. The sides are regularly rounded, not subvertical as is usual in *Echinostrephus*, and the greatest diameter is at the ambitus, not on the aboral side. The shape of the test is thus very different from the usual in *Echinostrephus*. There are four pore pairs on the ambulacral plates of the aboral side. Miliary tubercles are few, none separating the primary interambulacral tubercles as is the case in *Echinostrephus molaris*. The genital plates carry each two tubercles at their inner edge. Periproctal plates are few, rather large. There is no anal proboscis. The pedicellariae are not peculiar. The spines are as usual, the aboral ones the longest. They are purple with the tip white. The color of the test is a light bluish purplish, the apical system reddish purplish.

Locality.—Station 5558; in the vicinity of Jolo; Cabalian Point bearing S. 1.1 miles distant (lat. 5°51′33″ N., long. 121°00′58″ E.); 27 meters; coral; September 17, 1909. One specimen, the type.

Remarks.—This very handsome species differs particularly by the unusual shape of the test very conspicuously from the other species of the genus *Echinostrephus*. Probably it is only a young specimen, but the genital pores have been formed, though still quite small.

A more detailed description of this species, accompanied by the necessary illustrations, will be given in vol. 3, pt. 2, of my Monograph of the Echinoidea.

Genus ECHINOMETRA Gray

ECHINOMETRA MATHAEI (de Blainville)

Echinometra mathaei MORTENSEN, *Ingolf* Echinoidea, pt. 1, p. 128, 1903.—H. L. CLARK, Hawaiian and other Pacific Echini, Pedinidae, etc., p. 372, 1912; Catalogue of the recent sea-urchins in the British Museum, p. 143, 1925.

Localities.—Station 5108; China Sea, off southern Luzon; Corregidor Light bearing N. 39° E., 22.5 miles distant (lat. 14°05′05″ N., long. 120°19′45″ E.); 23 meters; coral; January 15, 1908. One young specimen.

Station 5140; in the vicinity of Jolo (Sulu); Jolo Light bearing S. 33° W., 6.1 miles distant (lat. 6°08′45″ N., long. 121°03′00″ E.); 139 meters; fine coral sand; February 14, 1908. Two specimens.

Port Binanga, Subig Bay, Luzon; January 9, 1908. Six specimens.

Nazug Bay, Luzon; January 16, 1908. One young specimen.

Marongas Island; February 10, 1908. One young specimen.

Tataan, Simulac Island; February 19, 1908. One specimen.

Jolo; shore; March 6, 1908. One specimen.

Endeavor Strait, Palawan; December 22–24, 1908. Two specimens.

Sirinao Island, Palawan; December 31, 1908. One specimen.

Verde del Sur Island, Palawan; April 6, 1909. Three young specimens.

Batan Island; June 5, 1909. Two specimens.

Macalubo Island; June 14, 1909. One specimen.

Remarks.—The finding of a specimen of this eminently littoral sea-urchin at a depth of 139 meters (station 5140) is so extraordinary that I cannot help suggesting that some mistake has occurred in the labeling. It has not otherwise been recorded from a greater depth than 34 meters, at which depth it was dredged by the *Siboga*.

ECHINOMETRA PICTA A. Agassiz and H. L. Clark

Echinometra picta H. L. CLARK, Hawaiian and other Pacific Echini, Pedinidae, etc., p. 373, pl. 95, figs. 6–12; pl. 114, figs. 5, 6, 1912.

Locality.—Apra Bay, Guam; November 19, 1907. Four specimens.

Remarks.—Without entering here on the question of the specific validity of *Echinometra picta*, or its possible identity with *E. mathaei*, I can only say that these specimens seem to me to fit well with the description of *E. picta* and to differ rather conspicuously in general appearance from the Philippine specimens of *E. mathaei*, so that it seems quite natural to keep them under a separate name.

ECHINOMETRA OBLONGA (de Blainville)

Echinometra oblonga H. L. Clark, Hawaiian and other Pacific Echini, Pedinidae, etc., p. 373, pl. 114, figs. 1, 2, 1912; Catalogue of the recent sea-urchins in the British Museum, p. 144, 1925.

Localities.—Port Binanga, Subig Bay, Luzon; January 9, 1908. Five specimens.

Nasug Bay, Luzon; reef; January 16, 1908. Three specimens.

Balayan Bay; January 18, 1908. One specimen.

Papatag Island, Tawi Tawi; February 23, 1908. One specimen.

Port Palapag; June 3, 1909. One specimen.

Batan Island; July 22, 1909. Six specimens.

Genus HETEROCENTROTUS Brandt

HETEROCENTROTUS MAMMILLATUS (Linnaeus)

Heterocentrotus mammillatus H. L. Clark, Hawaiian and other Pacific Echini, Pedinidae, etc., p. 378, pls. 115–117, 1912; Catalogue of the recent sea-urchins in the British Museum, p. 147, 1925.

Localities.—Tataan, Simulac Island; February 19, 1908. One specimen.

Mahinog, Camiguin Island; August 3, 1909. Three specimens.

Tidore Island; November 25, 1909. One specimen.

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